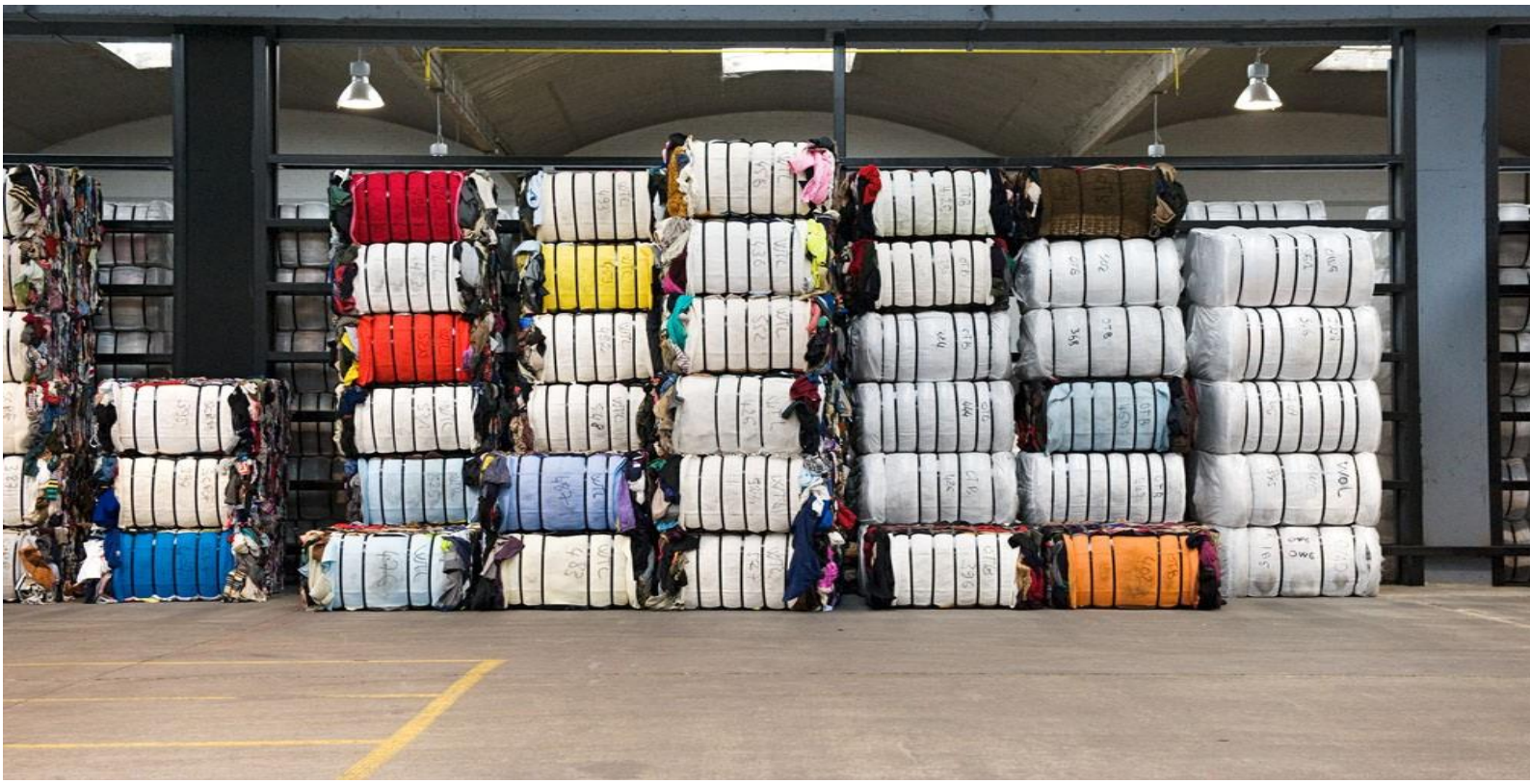
Using Behavioural Insights to Increase Textile Recycling in Urban Households: Testing Two Nudging Interventions

A case study of the municipality of Leiden



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Abstract

The textile and fashion industry is one of the most polluting and resource-wasting industries in the world. At the moment, approximately 55% of all end-of-life textiles are incinerated in the Netherlands as they end up in residual household waste. It is becoming imperative to examine effective ways to improve individual's textile recycling behaviour to facilitate a more sustainable and circular textile industry. This research seeks to understand how two nudging interventions, designed based on a framework from environmental psychology, can effectively increase textile recycling in the municipality of Leiden, which was used as a local case study. First, an online survey (n = 182) was conducted to explore the determinants of citizen's textile recycling intention (Study 1). The study used a comprehensive model in which the Norm Activation Model (NAM) and the Theory of Planned Behaviour (TPB) were combined. The multiple regression analysis reveals that attitude was the strongest determinant of intention to recycle textile, followed by outcome efficacy. Guided by the insights from the online survey and nudging theory, an informational nudge and an outcome efficacy nudge were designed and evaluated (Study 2). The effect of the nudging interventions was assessed by conducting a field experiment. The descriptive analysis shows a percentual increase in textile recycling in both treatments groups compared to the control group, however, the findings of the one-way ANOVA analysis demonstrate that this increase was non-statistically significant. Nevertheless, this research shows that the integration of TPB and NAM contributes to a more comprehensive model to encourage textile recycling behaviour. Future studies should investigate the application of the two nudging interventions at a larger scale and the long-term effects. Consequently, the implications of the findings are also discussed and suggestions are provided for local authorities to improve textile recycling schemes and campaigns.

Content

1. Introduction

The textile industry is currently not only one of the most polluting industries in the world, but also one of the most resource-wasting industries. At the moment, less than 1% of the material used to manufacture clothing is recycled into new clothing in a closed-loop system (Ellen MacArthur Foundation, 2017). Over 97% of input of the textile industry are new raw materials (97%), and the remaining 2% comes from recycled feedstock from other industries. The Ellen MacArthur Foundation (2017) found that "of the total fibre input, approximately 87% is landfilled or incinerated, representing a missed opportunity of over 80 billion euros annually" (p. 36). The consumption of textile is also strongly increasing while the usage and wearing time is decreasing (Cirkelwaarde, 2020). Combined with a declining demand for used textiles and the lack of recycling capacity in the Netherlands and Europe, the textile industry is under enormous pressure and facing a great circular challenge (Cirkelwaarde, 2020). The current aim worldwide is to achieve more circularity in textiles and fashion, which would enable clothes to re-circulate to new consumers and broken and worn out clothes to be recycled into new products. In order to achieve this objective, consumers themselves also play a crucial role (Harmsen & Bos, 2020).

As part of the Circular Economy Package of the European Commission, the European Waste Framework Directive states that the Netherlands have separate collection practices in place for the disposal of textiles by 2025 (European Commission, 2015). Directives set by the EU are binding, although each member state is free to choose as to how the objective shall be achieved (Europa, n.d.). Consumers have the power to decide when, where and how their textiles are disposed. Therefore, consumers determine the lifetime, destination and value of used textiles (Henzen & Pabian, 2019). Yet, the current textile collection rate in The Netherlands is only 44.6%, and this percentage is even lower in the larger cities: between 12% and 18% (Ffact, 2018; Watson et al., 2018). This means that approximately 55% of all end-of-life textiles are incinerated as they end up in residual household waste (Ffact, 2014). When textiles are incinerated, it is not only a major economic value loss but also causes environmental issues, such as increased greenhouse gas emissions and pollution (Ellen MacArthur Foundation, 2017).

The quality of the collected textile for recycling is also greatly decreasing due to contamination: over past five years, the average degree of contamination has increased from 8% to 15% (Vereniging Herwinning Textiel, 2019). The main cause of the increasing pollution is the current method for the collection of textiles. If a citizen accidently throws a garbage bag with

organic waste in the textile container, one third of the textile in the container will be unusable for recycling (Bakker, 2019). Not only does much residual waste end up in the collection containers, consumers are also often unaware of what type of textile can be disposed in the containers and what cannot. In particular, there is a lack of clarity about worn out or damaged clothes, and many consumers think that it is not eligible for recycling (GD142, 2018). Therefore, designing different strategies for textile collection in municipalities could have a significant impact on the total collection rate in countries (GD142, 2018).

More pro-environmental behaviour, such as textile recycling, might be stimulated by means of a social innovation called 'nudging'. In a nutshell, nudging is a tool that intends to influence people to act in a way intended by the designer (Thaler & Sunstein, 2018). The decision-making processes of individuals are not rational and are considerably influenced by psychological biases. Therefore, nudging can have large potential as it tries to overcome the limitations of the human brain and help individuals make better decisions. Nudging has been widely used to promote desired behaviour in health, wealth and happiness. For instance, nudging has been effective in reducing energy usage: Ayres et al. (2014) conducted two field experiments to examine whether the distribution of monthly peer comparison feedback could decrease the energy usage by households. The nudge contained information that compared residents' own energy usage to their prior usage and to adjacent similar households. The nudging intervention was greatly effective and made lasting reductions in energy usage.

Furthermore, there are also several studies that implemented nudges for recycling. Goldstein et al. (2008) used social norms signs in hotels room to improve the towel reuse rate. After introducing these signs with the text "the majority of guests reuse their towels", the reuse rates significantly increased from 35.1% to 44.1%. Moreover, Shearer et al. (2017) and Linder et al. (2018) focused on improving food waste recycling in households by using visual prompts and information leaflets. Shearer et al.'s (2017) study found a significant increase of 20.7% in the treatment group, which also persisted in the longer term. Linder et al. (2018) found that households who received information leaflets increased their food waste recycling with 26% compared to a pre-intervention average, which was significant even eight months after the intervention.

Increasing the separate textile collection rates and preventing textile from being disposed of in incinerators or landfills is vital in order to improve circularity in the textile industry. Since nudging has worked well in many other areas includes recycling, it might also encourage consumers to increase their textile recycling behaviour. To date, however, no empirical research

on textile recycling nudges has been conducted. Therefore, this study attempts to examine whether nudging could be an effective intervention in increasing household's textile recycling behaviour.

Before conducting a behavioural intervention such as nudging, the main psychological factors underlying the desired behaviour should be determined in order to design a successful intervention aimed at those factors (Steg & Vlek, 2011). Hence, this study also examines the specific psychological factors that motivate people to recycle textile. This thesis uses two of the most important and commonly applied theories to explain pro-environmental behaviour, namely the Theory of Planned Behaviour (TPB) and the Norm Activation Model (NAM). An emerging body of research has suggested combining multiple theories to illustrate the pro-environmental behaviour of individuals. This thesis therefore follows recent literature and combines both the TPB and NAM, as their combination enables the development of a more comprehensive framework (Do Valle et al., 2005; Park & Ha, 2014; Setiawan. Afiff & Heruwasto, 2020).

Thus, this study first tests a model in which constructs from NAM and TPB are combined to understand individuals' intention to recycle textile by using a survey. The municipality of Leiden is used as a case study as this offers the opportunity to generate an in-depth understanding of the intentions in a real-life context. The results of the survey will be used to determine which type of nudges should be designed for the intervention. Consequently, the potential of textile recycling nudges based on the relevant underlying behavioural factors are evaluated by performing a field experiment. The ultimate aim of the study is therefore to determine if nudging is an effective intervention in influencing textile recycling behaviour amongst households.

This thesis focuses on a main research question, which is formulated as follows:

To what extent is nudging an effective intervention in increasing the amount of household textile recycling in the municipality of Leiden?

1.1. Relevance for Industrial Ecology

This research is part of the master program Industrial Ecology. Industrial Ecology takes a systematic approach and focuses on society's metabolism from a socio-technical perspective in order to address sustainability problems (Leiden University, 2020). It aims to understand processes where materials and energy flows circulate, as well as the functioning and regulation of the industrial ecosystem and the interaction with the biosphere (Erkman, 2002; Saavedra et

al., 2018). In this way, the industrial system can be restructured to make it compatible with the functioning of a natural ecosystem (Erkman, 2002). The problem of interest in this thesis is relevant to Industrial Ecology as nudging interventions can influence the way in which individuals behave. In this way, it affects the functioning of society, in particular the waste management systems, in a more sustainable way. Increasing textile recycling behaviour will support the transition towards a more sustainable textiles economy as it can redirect textiles from the waste stream back into the circular economy as a valuable resource (Ellen MacArthur Foundation, 2017). The circular economy is a relevant concept to Industrial Ecology as its foundation is based on the theory of Industrial Ecology (Preston, 2012). Similarly to Industrial Ecology, circular economy refers to the analogy between industrial and natural systems. The industrial system is considered as subsystem of a larger ecosystem and aims to optimise material and energy flows in order to minimize the exploitation of natural resources and environmental emissions, hence working toward closed-loop systems (Bruel et al., 2019; Geng & Duberstein, 2008). Therefore, by focussing on improving circularity in the textile industry, this thesis also tackles one of the principles of Industrial Ecology, namely working towards closed-loop systems (Ayres & Ayres, 2002).

Finally, this thesis also utilizes tools and concepts learned from Industrial Ecology in order to critically evaluate textile recycling nudges and their implementation. Moreover, it takes an interdisciplinary perspective as nudging theory uses insights from psychology, social science and behavioural economics, and can be applied in many different areas such as government, business, health, safety and fundraising.

2. Conceptual Framework

In this section, the main concepts of this research will be explained. First, the concept of pro-environmental behaviour will be introduced, in addition to the framework that will be applied in this study and the current state of the Dutch textile collection practices. Furthermore, this chapter will also elaborate on two theories underlying pro-environmental behaviour: the TPB and the NAM, as well as the theory underlying nudging and the nudging typology.

2.1. Pro-Environmental Behaviour

As mentioned in the introduction, changing human behaviour plays a pivotal role in improving environmental sustainability. Pro-environmental behaviour can be defined as behaviour that seeks to minimize its impact on the environment, or even benefit it (Steg & Vlek, 2011). Currently, a great challenge for environmental psychologists lies in studying, explaining, and predicting how pro-environmental behaviour can be encouraged (Sörqvist, 2016). Environmental psychology is an area in psychology that studies the relationships between humans and the physical environment (Steg et al., 2013). In an integrated evaluation of pro-environmental behaviour research within environmental psychology, Steg and Vlek (2011) argued that promoting pro-environmental behavioural change is particularly successful when four key steps are followed:

(1) The first step is identifying the particular behaviour that needs to be changed. A researcher should select the behaviours that have negative environmental impacts (Steg & Vlek, 2011).

(2) The second step would be to examine the main factors that underlie the behaviour. The use of behavioural interventions is typically most successful if they are focused on two main aspects, namely on the significant antecedents of the desired behaviour and on eliminating the specific obstacles for change (Steg & Vlek, 2011). Hence, it is necessary to consider which variables encourage or hinder environmental behaviour. Factors underlying behavioural change could be internal and/or external. Internal motivations often concern weighing costs and benefits, normative and moral concerns, and affect (Steg & Vlek, 2011). In contrast, external factors such as the availability, accessibility, pricing or convenience may encourage or limit an individual's engagement in pro-environmental behaviour as well (Linder, Lindahl & Borgström, 2018; Steg & Vlek, 2011). Yet, the factors underlying behaviour are not mutually exclusive, and usually

behaviour results from a combination of motivations (Lindenberg, 2001; Heath & Gifford, 2002).

(3) The third step is designing an intervention to change the desired behaviour**.** Once the desired behaviour has been chosen and the main underlying factors determined, strategies for intervention can be designed aimed at those factors. There are different kind of strategies that can be used, such as informational or structural strategies (Messick & Brewer, 1983). Informational strategies mainly focus on altering prevailing norms, perceptions, motivations, and cognitions. The structural approaches concern adjusting the circumstances in which behavioural decisions are made (Steg & Vlek, 2011).

(4) The final step is to evaluate the effectiveness of the intervention. In order to determine if the intervention has been successful, a research is advised to follow a solid experimental design that is able to demonstrate the effects of single or multiple interventions for a single or multiple treatments groups and a similar control group (Steg & Vlek, 2011).

When the previous four steps are followed, resulting in behavioural interventions that are systematically planned, applied and assessed, interventions are typically more successful in promoting pro-environmental behaviour. Therefore, this study will follow these phases when designing a nudging intervention to promote the desired behaviour of textile recycling.

2.2. Textile Recycling

Currently, based on Article 10.21 of the Environmental Management Act, municipalities are obligated to collect household waste (Wet Milieubeheer, 2021). In accordance with the National Waste Management Plan (LAP), most municipalities currently also collect textiles separately (Ministerie van Infrastructuur en Waterstaat, 2017). However, following the amended European Waste Framework Directive, this agreement will be transformed into a legal requirement within the foreseeable future (Cirkelwaarde, 2020). Municipalities can decide themselves how they want to collect their household textiles, for instance by using textile containers or door-to-door collection. At the moment, 80% of all municipalities have contracts with commercial textile collecting companies to perform the collection (Watson et al., 2020). As municipalities bear the responsibility of organizing textile collection practices, they have gained a great deal of knowledge and experience with the complexity of textiles as a waste or raw material flow (Cirkelwaarde, 2020). Accordingly, municipalities themselves should take measures to stimulate and motivate more residents to offer the textiles separately, for example by designing

local solutions such as a collection structure suitable for the specific municipality (Cirkelwaarde, 2020).

Cities can collect considerably more textiles than they currently do (Rijkswaterstaat, 2018). Separate collection of discarded textiles is rarely done well in most European countries. Watson et al. (2020) estimated separate collection rates for household textiles in six countries in Europe. The Netherlands has a collection rate of 45%, which places it second, just before Denmark (44%) and after Germany (75%). Separate collection of textiles has increased in The Netherlands from 6.60 kg per capita in 2012 to 7.90 kg per capita in 2018 (Ffact, 2018). Yet, even at the higher collection rates, the amount of textile in residual waste also increased from 8.50 kg per capita in 2012 to 9.90 kg per capita in 2018. In total, approximately 55% of all end-of-life textiles are currently still incinerated as they end up in residual household waste (Ffact, 2018; Watson et al., 2018).

The textile collection rates also differ substantially between municipalities. For instance, some municipalities only collect 1 kg per capita, while others collect 10.40 kg per capita (Watson et al., 2020). Moreover, larger cities in the Netherlands seem to have much lower collection rate than the national average. For instance, Rotterdam, Amsterdam, The Hague, and Utrecht only have rates between 12% and 18% (City of Amsterdam, 2015). The main reason for the low collection rates in cities is the large share of multi-family housing in cities, which reportedly discard fewer textiles than other housing types: areas that primarily consist of low-rise buildings generally have collection rates that are 60% higher than that of areas that primarily consist of high-rise buildings (City of Rotterdam, 2013). Therefore, designing different methods for collecting textiles in large cities such as Leiden might have a significant impact on the total collection rates in countries (Watson et al., 2018).

Furthermore, the collected textile stream is also very susceptible to contamination, and the current quality of these streams is considered to be problematic (VANG, 2019). Regarding textiles, there are several ways to define the word ‘quality’. On the one hand, it can mean the value of the clothing or materials that determine whether a garment is still wearable and has sufficient economic value, or whether it can be recycled into fibres. On the other hand, the collection method can also influence the quality of the textile. Moisture or other waste flows, such as residual waste, can cause the entire collected cargo to be rejected (VANG, 2019). For this paper, the second definition is most relevant.

The majority of municipalities use underground textile containers to collect the textile of households. However, underground containers are often seen as a problem by textile collectors since moisture, which usually is rain or groundwater, can get into the textile container. In addition, contamination with other waste flows is also increasing. The sector organization for the textile recycling industry (VHT, 2019) indicates that the contamination has increased from 8.2% in 2014 to 12.5-15% in 2019. According to Sympany (2020), the company that is responsible for the sorting of the textile that consumers dispose of in textile containers in Leiden and other municipalities in the Netherlands, around 15-20% of waste ends up in the textile containers. As Sympany collects around 20 million kilos of textile per year, this percentage accounts for a few million kilos of waste per year. This waste mainly consists of residual waste, synthetic pillows, mattresses, duvets, but also glass, injection needles, and wet or heavily soiled textiles (Sympany, 2020; VANG. 2019). Contamination of the textile with other waste streams or with wet textiles could lead to all textiles becoming unusable for reuse or recycling and result in extra costs during the processing and sorting (VANG, 2019).

There is a great unawareness among consumers about what can be disposed of in the textile containers and what cannot (Bakker, 2019). In this research, textiles meant for recycling containers are defined as clothing (also swimwear and underwear); shoes; curtains; bedding (sheets, blankets, pillowcases, duvet covers); socks and stockings; accessories (belts, bags, ties, ties, hats, scarves, caps and gloves); stuffed animals, and cleaning cloths and rags. However, floor covering (mats and carpets); mattresses, pillows and duvets; wet textiles and wet shoes; clothes with paint or oil stains; pillow or toy filling, and knitting yarn are excluded as they belong in the residual waste containers. It is also important that clothes are dry and clean before they are disposed in the textile containers, and that all clothes are put in a sealed plastic bag (Sympany, 2020). In particular, there is a lack of clarity about worn out or damaged clothes, and many consumers think that it is not eligible for recycling (GD142, 2018). Therefore, to change consumer's behaviour regarding textile recycling, the knowledge of households about textile collection and recycling needs to increase (Bakker, 2019; Vereniging Afvalbedrijven, 2019).

2.3. Theories Underlying Pro-Environmental Behaviour

2.3.1. Theory of Planned Behaviour

In order to explain pro-environmental behaviour, one of the most important and commonly applied theories is the TPB, which is an extension of the Theory of Reasoned Action (Ajzen & Fishbein, 1975; Azjen, 1991). TPB is based on a rational choice model and relies on the fact that humans are motivated by self-interest and weigh costs and benefits. The theory has demonstrated that the strongest determinant of behaviour is intention when assessed prior to the time the behaviour is performed. Intention is a function of perceived behavioural control, subjective norms and attitudes (Azjen, 1991). The stronger the intention, the more likely it is that the behaviour will be performed. The TPB model hypothesizes that an individual's intention to perform a pro-environmental behaviour should increase if one has a positive attitude towards the pro-environmental behaviour, if one believes that significant others endorse the behaviour or perform pro-environmental behaviour themselves (subjective norm), and if one believes to have control over the behaviour (perceived behavioural control) (de Leeuw et al., 2015).

Perceived behavioural control is based on control beliefs and refers to an individual's ability to perform a certain behaviour. It is assumed to reflect past experiences and anticipated factors that promote or impede the adoption of the behaviour (Azjen, 1991). Subjective norms have two components, namely injunctive and descriptive norms. Injunctive norms are focused on the expectations individuals have of what important referents, such as friends or family, believe they ought to do. The component of descriptive norms refers to the individual's perception of the actual behaviour of the important referents. Lastly, attitude can be seen as a person's evaluation of the consequences of a particular behaviour (Ajzen & Fishbein, 2011; Rivis & Sheeran, 2003).

While TPB has been applied in a multitude of studies to investigate general recycling behaviour, it has hardly been used to specifically investigate textile recycling behaviour. One study found by Henzen and Pabian (2019), used an extended TPB model including knowledge of textile recycling, industry awareness, and personal norm to investigate four types of post-consumer textile disposal intention: extending the lifespan of textiles, disposing unwanted textiles between household waste and incentive and non-incentive-based textile disposal. The results demonstrated that personal norm, subjective norm and industry awareness are predictors of the intention to dispose without incentive. Yet, industry awareness and personal norm have a negative impact on the intention to dispose unwanted textiles between household waste.

Moreover, they found that perceived behavioural control and knowledge of textile recycling did not significant influence any of the behavioural intentions (Henzen & Pabian, 2019).

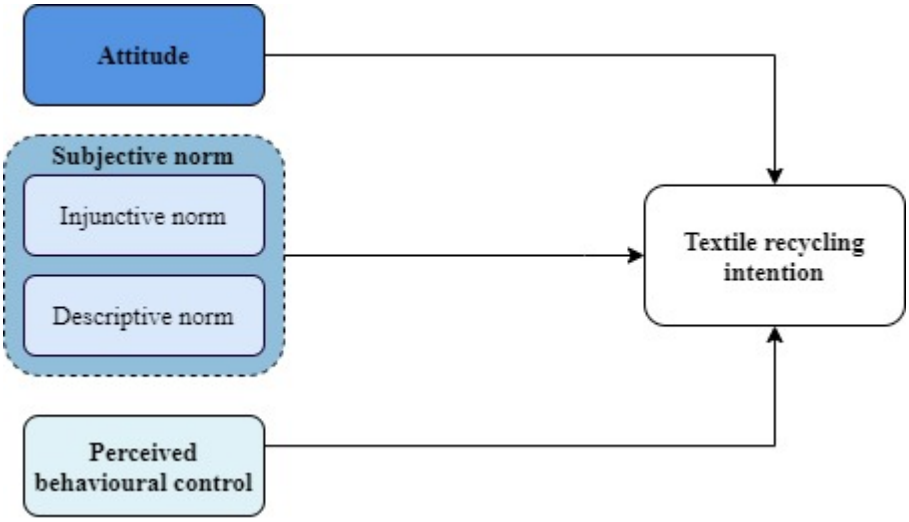
Nevertheless, TPB has been used very often to explore other types of recycling behaviour, such as household recycling (Boldero, 1995; Chang & Bishop, 2013), wastepaper recycling (Cheung, Chan & Wong, 1999), recycling participation (Davis et al., 2006), the disposal of household waste (Knussen & Yule, 2008), and waste separation intention (Nguyen, Zhu & Le, 2015; Vassanadumrongdee & Kittipongvises, 2018).

The theory is open for the inclusion of additional predictors, and the literature indicates that including additional variables can lead to an improved explanation of recycling behaviour. Therefore, numerous studies have added additional variables as predictors such as moral norms (Botetzagias et al., 2015; Heidari et al., 2018; Poškus, 2015; Razali et al., 2020; Tonglet, et al., 2004), environmental concern and perceived moral obligation (Cheng & Tung, 2014), situational factors, consequences of recycling, environmental awareness (Heidari et al., 2018; Cheng & Tung, 2014; Tonglet, Philips & Read, 2004), demographic information and previous recycling behaviour (Botetzagias et al., 2015; Tonglet et al., 2004).

The TPB model can be found in Figure 1. The survey that will be utilized in this research will measure the intention to perform textile recycling as the behaviour itself cannot be measured. As mentioned above, the variables attitude, subjective norm and perceived behaviour control all influence the intention to perform textile recycling. A favourable attitude towards textile recycling is formed when the overall evaluation of performing the behaviour is positive, which helps to increase recycling. In contrast, a negative attitude can be developed when the individuals believes that recycling is harmful, which often leads to an unfavourable attitude (de Leeuw et al., 2015; Setiawan et al., 2020). Subjective norms can be seen as the social pressure experienced by individuals to perform textile recycling behaviour. Descriptive norms are based on whether important referents perform textile recycling and injunctive norms on whether important referents believe that the individuals should perform textile recycling. Both these norms can therefore guide an individual's judgement as to whether the behaviour is appropriate. Moreover, when a person believes that he or she has the ability and capability to engage in textile recycling, the perceived behavioural control tends to increase.

Figure 1

The Theory of Planned Behaviour



2.3.2. Norm-Activation Model

Research has confirmed that important predictors of pro-environmental intention are personal (or moral) norms (Bamberg & Möser, 2007). Hence, personal norms are included in a great number of studies and have been proven to strongly predict household recycling and waste separation behaviour (Botetzagias et al., 2015; Chan & Bishop, 2013; Heidari et al., 2018; Tonglet et al., 2004; Xu et al., 2017).

Due to this importance of personal norms, research on recycling behaviour has been framed by using Schwartz's NAM (Hage, Söderholm & Berglund, 2009). NAM is a pro-social theory and is frequently applied to study altruistic behaviour based on an individual's moral considerations (Schwartz, 1977). The model can be used to study general environmental friendly behaviour (Schultz, 1998; Steg & Nordlund, 2018) as well as more specific intentions and behaviour such as recycling (Hage, et al., 2009), waste reduction behaviour (Van der Werff et al., 2019) public transportation usage (Bamberg, Hunecke & Blöbaum, 2007) or adaptation of electric automobiles (He & Zhang, 2018).

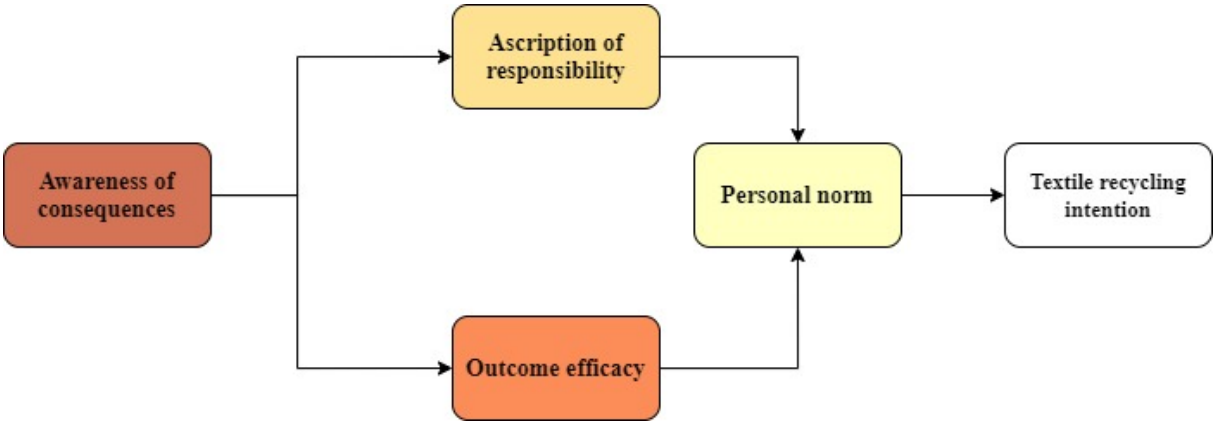
The core component of NAM is the personal norm, which can be defined as "feelings of moral obligation to perform or refrain from specific actions" (Schwartz, 1977, p. 191). Personal norms differ from the subjective norms that are analysed in the TPB. Whereas personal norms highlight intrinsic values, subjective norms emphasise the normative influence of important referents and act more as extrinsic factors influencing recycling and waste sorting behaviour

(Park & Ha, 2014). In Schwartz's (1977) original model, he predicts that this feeling of moral obligation is most likely to occur when an individual is (1) aware of the consequences of the action, (2) ascribes responsibility for these consequences to oneself, (3) identifies actions to relieve the needs of others or things one values, defined as outcome efficacy, and (4) recognizes their own ability to provide relief. When these values exist, individuals develop internalized feelings of moral obligation, which encourages pro-social behaviour (Matthies, Selge & Klöckner, 2012). Yet, the bulk of literature rarely includes all four variables in their studies and most studies on pro-environmental behaviour only include awareness of consequences and ascription of responsibility (Hage et al., 2009) or outcome efficacy (Van der Werff et al., 2019). Even though these studies have been successful in explaining these types of pro-environmental intentions and behaviour, there is still confusion about how to properly interpret NAM, which makes it challenging to draw strong conclusions on the benefits of the model.

This research uses the model proposed by Steg and de Groot (2010), who investigated different interpretations of NAM in three studies. In these studies, they included either ascription of responsibility or outcome efficacy and concluded that the NAM can best be interpreted as a mediator model. This kind of model tries to identify and explain the process underlying the relationship between an independent and dependent variable by adding a third hypothetical variable, called the mediating variable (Baron & Kenny, 1986). In this research, however, both ascription of responsibility and outcome efficacy are included instead of only one of the two. Ascription of responsibility has been demonstrated to influence pro-environmental behaviour such as recycling behaviour in previous literature. Outcome efficacy has often been excluded in the NAM recycling literature, still Steg and de Groot (2010) mention the importance and relevance of outcome efficacy in large-scale problems that require collective actions such as reducing greenhouse gas emissions. Therefore, the NAM in the current research includes both variables in addition to ascription of responsibility (Figure 2).

Figure 2

The Norm Activation Theory



Hence, in order to influence behaviour, a specific norm must be activated for which problem awareness, ascription of responsibility and outcome efficacy are important. This means that to influence textile recycling behaviour, households should believe that the generated textile waste harms the environment, that they bear the responsibility for the textile problems and believe that they can contribute to alleviating the problem (Setiawan, Afiff & Heruwasto, 2020; Steg & de Groot, 2010).

2.3.3. Exploration of Both TPB and NAM Regarding Textile Recycling

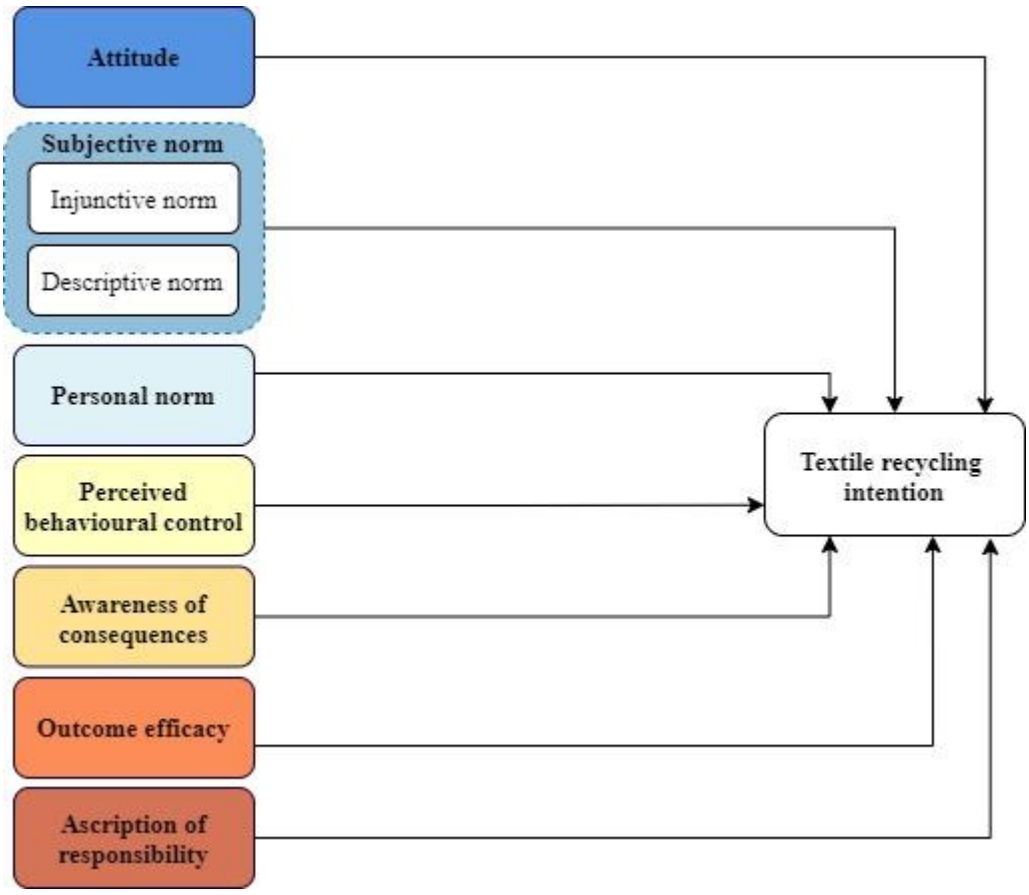
This study follows recent literature and combines both TPB and NAM in order to examine intention for textile recycling (Do Valle et al., 2005; Park & Ha, 2014; Setiawan et al., 2020). The combination of the two models is based on the observation that in the majority of studies, the intention to recycle results from a mixture of pro-social and self-interest motives (Miafodzyeva & Brandt, 2013). The NAM is mainly applied to interpret the pro-social part of pro-environmental behaviour, while TPB is applied to explain the self-interest part of pro-environmental behaviour. The application of merely one model might not be sufficient in explaining recycling behaviour as this behaviour consist of both types of motives (Miafodzyeva & Brandt, 2013). Hence, combining NAM and TBP can offer useful perspectives in order to explain pro-environmental behaviour and enhances the theories power to predict individuals pro-environmental behaviour (Bamberg & Möser, 2007; Han, 2015; Lui et al., 2017; Shi, Fan & Zhao, 2017; Zhang, Geng & Sun, 2017). For example, in their detailed examination of the integration of the two models, Setiawan et al. (2020), showed that it provides a more comprehensive perspective for relevant actors to encourage waste separation behaviour of the targeted population.

To the knowledge of the author, the only textile related study that used the combination of TPB and NAM was conducted by Stols (2016). She used the combination of TPB and NAM to explain female consumers' pro-environmental apparel disposal motivation and intention in the South African context. The study found that most consumers are aware of the environmental impacts related so textile disposing. Social norms and attitude were the strongest predictors of the intention to dispose of textile in an eco-friendly manner, while perceived behavioural control was the weakest predictor.

To better understand the determinants of households' textile recycling behaviour, this research combines TPB and NAM variables, and suggests the model as presented in Figure 3. Due to the scope of this research, the mediating relationships in the NAM model were omitted and only the direct influences on intention were measured. Measuring the direct influences on behavioural intention is of most importance to this research as it allows the direct inclusion of these variables in the nudging design.

Figure 3

Combination of both TPB and NAM



2.4. Nudging

The concept of nudging is based on insights from behavioural economics and psychology, and is a tool that can be implemented by choice architects aiming to direct consumers to a preferred direction (Blumenthal-Barby & Burroughs, 2012). Research has shown that humans systematically fail in their ability to make decisions that can reach their desired outcomes (Hansen & Jespersen, 2013). Therefore, nudging could help to gently push humans in the direction of making more sustainable decisions. Thaler and Sunstein (2008), who introduced the concept, define nudging as ”*any aspect of design that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives”*. This chapter elaborates on the concept of nudging. First, the dual process theory is explained, the underlying theory of nudging, after which green nudging is described and a nudging typology is provided.

2.4.1. Dual-Process Theory

On a typical day, the human brain continuously makes decisions. The primary theory that underpins most of our modern interpretation of human cognition and decision-making is recognised as the dual-process theory (Evans, 2000). This theory concerns two mechanisms that together determine how humans assess and choose between alternatives: System 1 and System 2. System 1 is an automatic and intuitive process that mainly operates fast and involuntarily. In contrast, system 2 is reflective and deliberate, which operates slower and requires mental exertion to carefully evaluate alternatives (Kahneman, 2003).

In general, System 1 and System 2 work in tandem: the intuitive assumptions made by System 1 are often communicated to System 2's calculative, attentive nature. This implies that System 2 is mainly responsible for observing and controlling thoughts and actions proposed by System 1, which causes some thoughts or actions to be expressed immediately in behaviour while other thoughts are restrained or altered (Hansen & Jespersen, 2013; Kahneman, 2012). Therefore, if a human want to make a decision, e.g. whether to purchase renewable energy or fossil fuels from a supplier, both of the systems may get involved.

However, humans frequently rely only on the automatic mode of System 1 when they need to make a quick decision, lack sufficient information or experience, are missing appropriate feedback, or are experiencing unanticipated thoughts or emotions (Selinger & Whyte, 2011). For most everyday tasks such as biking home from work or walking to the grocery store, System 2 processes might never step in due to its slowness, and are left to System 1 (Momsen & Stoerk,

2014). Individuals are therefore vulnerable to behavioural biases and do not make conscious decisions, but depend on mental shortcuts and habits (Lehner, Mont & Heiskanen, 2016).

Nudge theory is centred around the dual-process theory. Nudging aims to figure out ways to reduce the detrimental effects of automatic thinking of System 1 (Selinger & Whyte, 2011). It presumes that individuals will continue to rely on automatic past ways of thinking and behaving unless they are triggered to act or think differently (Shearer et al., 2017). A nudging intervention, therefore, makes changes in the decision-making context by capturing and utilizing, or capturing and blocking the cognitive biases and errors of System 1 processes. The majority of nudges focus only on System 1 and target automatic processes. However, depending on the design of a nudge, it can also indirectly address the analytical and deliberate decision-making of System 2. System 2 is initially dormant, however if engaged, it will interact with System 1 and decide whether to not to use input from the automatic process (Hansen & Jaspersen, 2013; Schubert, 2016; Sustein, 2014). The different nudging types and designs will be further elaborated in the following sections.

When a nudging intervention is designed well, it helps to prompt and guide individuals, often in subtle ways, towards different decision pathways without the individual's awareness. However, since nudges could have a substantial impact in altering the behaviour of humans in ways they are unaware of, Thaler and Sunstein (2008) demanded that choice architects whom design nudges adhere to certain guidelines to make sure its influence is not exploitative. The designed nudge should therefore be inexpensive to apply, keep monetary incentive structures largely intact, be easy to opt-out of, transparent and should only be intended to assist individuals to live according to their best interests. Nudges should always preserve all the available choices. Lastly, sanctions and fines do not qualify as nudges since they alter the decision-making context completely by changing incentives and adding costs and that were not there before (Selinger & White, 2011).

2.4.2. Nudging for the Environment

This research will focus specifically on nudging for the environment, which is called green nudging. Households are accountable for a large share of global greenhouse gas emissions and can contribute significantly to mitigating climate change. Addressing the customs of individuals, however, can be challenging since psychological factors such as bounded rationality are important and often difficult to address with public policies (Evans et al., 2017). Bounded rationality is based on the belief that rationality is limited when humans make decisions. When a person makes a decision, there are limits to their thinking capacity, available

information and time, which means the decision-making process is usually not optimised. It is therefore important that policymakers are careful when wanting to push citizens into a certain type of desired behaviour as their efforts often fail due to these psychological barriers. In addition, material factors such as infrastructure and the attitude-behaviour gap play an important part in limiting pro-environmental behaviour (Evans et al., 2017; Kollmuss & Agyeman, 2002). For example, even if an individual has knowledge about a certain issue, it does not always result in adopting a more sustainable habit (Centre d'analyse strategique, 2011).

In order to counter these barriers and close the attitude-behaviour gap, up until recently scientists have mainly used different policy instruments based on the assumption that humans are rational actors (Carlsson et al., 2019). Yet, since it has been demonstrated that humans have bounded rationality, are subject to biases, and often do not make intentional choices, this had led to the incorporation of behavioural insights into environmental policies. Green nudging is one of these strategies and is defined as a "change in any aspect of the choice architecture that is intended to alter people's behaviour in a predictable way and result in a reduction of a negative external effect without forbidding any options or significantly changing the economic incentives" (Carlsson et al., 2019, p. 2).

As mentioned before, nudging strategies mostly function within the more automatic and intuitive thinking mode of System 1. The traditional policy tools such as regulatory, economic and information policies, however, generally overlook the fact that the majority of human behaviour is automatic (Schubert, 2016). They primarily target System 2 processes, relying on the availability of information as well as people's cognitive ability to process this information and make rational choices. Therefore, this attribute of targeting System 1 differentiates nudging from the traditional environmental policy toolkit and makes it a potential valuable addition (Schubert, 2016).

Moreover, nudging is especially useful for environmental problems due to the behavioural nature and complexity of these problems. Since green nudging integrates and acknowledges behavioural insights into its approach, it can be very effective in regulating environmentally damaging behaviour (Momsen & Stoerk, 2014). Thus, when designed well, nudges for textile recycling could potentially be used as a policy instrument in the future as it might increase the collection rates of textile and improve the quality of the disposed textile (von Kameke & Fischer, 2018). Therefore, in this study green nudging is introduced as a possible soft, non-

regulatory expansion to the conventional environmental policy instruments. In the next paragraphs, different types of green nudging will be outlined as well as their characteristics.

2.4.3. Typology

There is an increasing amount of literature on green nudges, and many authors have categorised nudges differently. This research follows the proposed typology of Evans et al., (2017), which represents a mixture of previously developed typologies and leans on the System 1/System 2 model used in Hansen and Jespersen (2013). Using a typology of green nudges allows for a better comprehension of the underlying psychological mechanisms, which will be beneficial during the design phase of the nudging intervention (Lin, Osman and Ashcroft, 2017). All available nudging types will be discussed in this section since the type of nudge that this research will focus on, will only become evident after analysing the results of the survey.

Evans et al. (2017) make a distinction between passive nudges and activating nudges. Passive nudges affect System 1's unconscious, repetitive behaviour and do not require extra mental activity by the individual. Activating nudges utilize System 1 mechanisms as well but also direct the person to assess and evaluate possibilities before decision-making, and therefore also use System 2. Consequently, both types of nudges are also grouped on the underlying psychological mechanism. The typology will be explained in the following paragraphs.

2.4.3.1. Passive Nudges

Green opt-in/out defaults are nudges that take advantage of the status quo bias. The status quo bias signifies the general tendency of individuals to remain in their current situation (Samuelson & Zeckhauser, 1988). Green defaults exploit this bias by setting the preferred pro-environmental choice as the default option. Examples of the opt-in/out nudge include a double-sided printing default (Egebark & Ekström, 2013) or preselecting the renewable energy option on energy contracts (Momsen & Stoerk, 2014). Physical defaults refer to modifications to the physical properties of the choice architecture. This creates a new default by placing constraints on the available alternatives without completely removing them. A known example of a physical default is the reduction of plate size to reduce food waste by Kalbekken and Sælen (2013), as mentioned in the introduction.

When one makes ecological options more visible, for example by placing vegetarian options at eye level in the supermarket, an alteration is made to the arrangement of the choice architecture. This is referred to as a feature position design (Evans et al., 2017).

Likewise, feature salience also seeks to make sustainable options more visible through highlighting only certain aspects of the choice architecture, e.g. a device that displays real-time energy usage and turns red at high energy consumption levels and green at low energy levels. Lastly, visual illusions apply common visual signals to induce a specific desired behaviour, such as using white stripes painted onto the road to reduce the speed limit (Thaler & Sunstein, 2008).

When individuals are primed, they are shown an informational message or visual stimuli associated with an environmental issue (Evans et al., 2017). According to research, subtle influences can enhance the ease with which certain information comes to mind. Priming works with the automatic system of the brain while still being a noticeable element of the choice architecture. An example is environmental messages in toilets aiming to increase the purchase of package-free produce (Tate, Stewart & Daly, 2014).

2.4.3.2. Activating Nudges

Eco-labelling mainly uses point-of-purchase messaging as a nudging intervention. An example of salience eco-labelling is the energy efficiency labelling scheme from the European Commission, providing labels with a clear and simple indication of the energy efficiency (European Commission, 2012). It is considered as a choice architecture element and not merely information provision as it affects the consumers directly at the point-of-purchase. In addition, eco-labelling can also be expressed in the form of gains and losses, e.g. the amount of energy lost or saved by switching to another model. This form of eco-labelling uses the cognitive biases of loss aversion and framing effect in order to promote pro-environmental behaviour (Evans et al., 2017). Lastly, energy efficiency labels can also relate to the social norms that exist in a society. When eco-labels function through implicit social norm framing, they can appeal to an individual's self-image and desire of belonging to an a more sustainable society (Schubert, 2016).

Green social norms can be divided into three categories: descriptive, injunctive and comparative norms (Cialdini et al., 1990). Descriptive social norms refer to perceptions of how individuals behave, such as feedback on the amount of energy consumed per month (Schultz et al., 2007). Comparative social norms compare information of how different individuals behave. Using the same example as before, individuals will now receive information on the average amount of energy consumed by their neighbourhood. Injunctive social norms reflect perceptions of what is approved or disapproved by others. These norms can also be added to the previous example by including visual feedback such as a happy or unhappy emoticon to their energy information.

Another green social norm is a commitment nudge. This works by setting a particular goal, such as an energy reduction goal. These goals are considered to be very effective as it involves social pressure, the influence of reciprocity, the desire to uphold consistent behaviour and cognitive dissonance (Cialdini, 2007).

Active choice nudges are also called promoted choice nudges. These sorts of nudges are structured in such a way that no default is included, but it forces the receiver of the nudge to make a conscious decision between a range of alternatives before proceeding (Evans at al., 2017). Some researchers view the active choice nudge as less controversial and hence a more ethically responsible solution compared to opt-out nudges (Gigerenzer, 2015).

To conclude, it should be noted that not every nudge falls completely into one nudge category. It could occur that a specific nudge falls into two or more categories (Evans at al., 2017). Simplification nudges are an example of this, which are design nudges that frame important complex information in more simplified terms so it fits the processing capabilities of the individual. Therefore, they also fall in the category of activating nudges as they aid people in avoiding cognitive fatigue and the risk of being subjected to a System 1 bias (European Commission, 2016).

2.4.4. Additional Aspects Concerning Nudges as Policy Instruments

All in all, from a policy standpoint, nudges have at least four beneficial aspects contrary to other policy tools. Nudging is a relatively low-cost measure, as well as a tool that is accessible and easily adapted to numerous situations (Thaler & Sunstein, 2008). Moreover, before rolling the intervention out to the whole population, nudges can be tested for viability and effectiveness in a pilot experimental study (Carlsson et al., 2019). Evaluating the intervention in a pilot study could save a great deal of money and time, in addition to offering insights on behaviour that have not been anticipated earlier. However, it must be noted that nudging should be used in combination with more stringent policies, and not function as a replacement: green nudges should be deemed as potential complements with the aim of supporting the gradual shift of society towards a more sustainable future (Ferrari et al., 2019).

Despite the fact that nudging could be a valuable addition to the policy toolkit, it has also received some important ethical criticism. First of all, nudging has received criticism for its potential to jeopardise Western society's democratic processes. Marteau et al. (2011), for instance, found a potential threat in nudging in its implicit tendency to manipulate individuals or withhold information. Moreover, Felsen et al. (2013) argue that influencing citizens'

behaviour by using the subconscious approach of nudging might cause an adverse reaction in citizens' perception of governmental behaviour change interventions: it could estrange citizens from the public agenda as they might regard these interventions as coercive and as an infringement upon one's own autonomy.

In order for environmental policy measures to work, they must be accepted and perceived as fair (Gowdy, 2008). However, nudging's redistributive impact could be perceived as unfair by the public. When nudges are applied to achieve common goods, such as greenhouse gas reduction, there might be a possibility that these interventions will permit a small group of well-informed people to free ride on the efforts made by the majority of citizens. According to Sunstein and Reisch (2013), nudging generally has the most impact on the uninformed and uneducated segments of the population. Hence, as disputed by Lehner, Mont and Heiskanen (2016) "it is democratically worrying to use nudging to influence the behaviour of those not able to identify a nudge, while allowing those that are able to identify it, and thus avoid it, escape the costs while benefitting from the gains." (p. 175) .

These criticism mentioned do not only count for nudging, but apply to the wider concept of 'libertarian paternalism', in which nudging has its origins (Thaler & Sunstein, 2009). The libertarian part of the concept lies in the fact that people should maintain freedom of choice, and paternalist in the way that it is legitimate for the public sector to try to influence people in directions that will promote their own welfare (Thaler & Sunstein, 2009). The philosophy of libertarian paternalism thus believes that individuals are free to make choices, but that the choice architecture should be designed in such a way that it promotes a specific desired behaviour (Thaler & Sunstein, 2009).

There is an ongoing discussion concerning the ethics of libertarian paternalism, with two specific aspects being most criticised. To start with, an issue that is heavily debated is the extent to which the government should intervene in changing people's behaviour. In general, what tends to determine a person's attitude and support for a given nudge are the specific ends the nudge tries to pursue (Tannenbaum, Fox & Rogers, 2017; Reisch & Sunstein, 2016). The most important distinction is between paternalistic and non-paternalistic ends. Green nudges aim to promote pro-environmental matters, and are regarded as non-paternalistic since they seek to increase social welfare. When paternalistic ends are pursued, the objective is to improve an individual's own well-being. Non-paternalistic nudges tend to face the least criticism, which might be caused by the fact that these measures serve a legitimate public interest in the form of environmental protection (Evans et al., 2017; Schubert et al., 2017). Moreover, the specific

social or cultural context in which the nudge is applied is also relevant. For instance, American citizens usually have a completely different approach to freedom of choice compared to European countries such as Sweden (Frerichs, 2011), and other aspects such as the interest and values of a certain country are important to consider. Yet, the majority of people surveyed from Western countries show strong support for nudging interventions in general, as long as they are sufficiently transparent (Reisch & Sunstein, 2016).

This leads us to the second point of discussion, the transparency of nudging tools. In order to make green nudges more effective and ethical, it is key to ensure that they are designed in a transparent way (Schubert, 2017). A nudge is considered to be transparent when the intention behind the nudge as well as the mechanisms by which behavioural change is attained, can be expected to be reasonably understandable to the individual being nudged (Hansen & Jespersen, 2013). The issue of transparency is critical as nudges have been accused of being manipulative. In addition, critics also claim that there is a danger that governments could abuse the power of nudges. As suggested by House of Lords (2011) and Lehner, Mont and Heiskanen, (2016), having a democratic open dialogue with citizens about the application of nudges for pro-social or pro-environmental purposes is important for governments to avoid backlash. Therefore, to improve ethical legitimacy, it is important that citizens know the different nudging interventions that are being utilized in addition to being able to identify them if they would like to (Lehner et al., 2016).

3. The Current Study

In order to answer the main research question, the four phases from Steg and Vlek (2009) presented in the conceptual framework will be followed. First, the selected pro-environmental behaviour for this study is textile recycling. Second, in order to examine the main factors underlying textile recycling an online explorative survey will be conducted, referred to as Study 1. Third, the results of the survey will be used to determine which type of nudges should be designed in the context of the municipality of Leiden. Finally, a field experiment will be performed in order to test the effectiveness of the nudges that were designed specifically for this study. The design of the nudge as well as the field experiment are referred to as Study 2. The survey and experiment both use the case study of the municipality of Leiden as this offers the opportunity to perform an in-depth investigation focused on a specific context and target group in the municipality of Leiden.

3.1. The Case Study: Leiden

Leiden is a historic city in the Netherlands, located in the province of South-Holland. On the 1st of January 2021, Leiden had 124,096 inhabitants. It is densely built and currently has 59,832 dwellings (Gemeente Leiden, 2021a). With regard to the key demographics, Leiden differs from the national demographics in certain areas.

Regarding the type of households, Leiden primarily has one-person households (54%), while the groups of other household types are relatively small. The inhabitants of Leiden are also relatively highly educated (43% vs. 28% nationally). The population of Leiden consists of 51% females and 49% males, which does resemble the national average. Currently, the city is experiencing population ageing in combination with a decline in the number of young people. In comparison to the year 2000, Leiden has 8% less inhabitants under 18 years old, and 34% more inhabitants over the age of 65 (Gemeente Leiden, 2018). However, the age group of 18 to 26 years has increased by 28% since 2000. Approximately 25,000 young adults live in Leiden at the moment. More than half of the age group of 18 to 26 years is a university (WO) or university of applied sciences (HBO) student. This is 20% of all residents of Leiden, while this percentage is only 11% nationally. The increasing number of students is mainly due to the large number of student residences built in recent years and students moving to the city who lived outside of Leiden before. Currently, most of the students live in the city centre while families and elderly mainly live in the suburbs (Gemeente Leiden, 2018).

3.2. Textile Collection System in Leiden

In the municipality of Leiden, household waste such as paper, glass and textile are collected separately by using collection containers. All the above-ground collection containers have been replaced by underground ones in recent years. Throughout the city, 65 textile recycling containers are distributed in the different neighbourhoods (Gemeente Leiden, 2021b). On the textile container a label is attached which indicates what can be discarded in the container, such as clothes, bedding, (tea) towels, bags, old rags, curtains, hats and caps, shoes and stuffed animals (Figure 4). The textile containers are regularly emptied by municipal collection services. The municipality keeps records of the amount of textile in each container and accordingly makes a fitting schedule for the collection agency (Veelenturf, 2020). For instance, the containers in some neighbourhoods are cleared every week while others might only be cleared once every two weeks.

In Leiden specifically, per year approximately 15 kg of textiles per inhabitant gets disposed. However, two thirds of this amount still ended up in residual waste in 2019. There are some differences between neighbourhoods. The percentage of textile in residual waste is especially large in the neighbourhoods with high-rise buildings: approximately 7.1% compared to 3.1% in the city centre and 3.7% in low-rise neighbourhoods (Gemeente Leiden, 2020).

Figure 4

Textile containers in Leiden (Unity, 2018; van Duin, 2020)

4. Study 1: Survey

4.1. Methodology

4.1.1. Participants and Design

A quantitative research method was followed to apply the NAM and TPB models to textile recycling intention in Leiden. The constructs of NAM and TPB were measured to test for their predictive values and the survey consisted of fixed-format questions, which required participants to select an answer from predefined available responses. The dependent variable in this research was the intention to recycle textile, while the predictors were the constructs of NAM and TPB.

In March and April 2021, inhabitants of Leiden were surveyed by using the Leiden Panel, which is an online panel established by the municipality of Leiden. This panel consists of approximately 600 inhabitants of Leiden, who are randomly chosen by the municipality. Through this panel, residents provide information on various topics at specified intervals during the year. According to the municipality, this panel ensures a reliable and adequate representation of the beliefs and perceptions of the population of Leiden (Gemeente Leiden, 2020).

All residents of Leiden over the age of 18 were targeted in order to obtain an adequate number of responses and ensure a more reliable sample. As mentioned before, all neighbourhoods in Leiden have numerous textile recycling containers located in close proximity to the dwellings. Therefore, all inhabitants have the opportunity to recycle their textile and could be approached to participate in this survey.

In total, 205 surveys were returned. After discarding questionnaires including missing values, the final total of usable questionnaires was 182. The response rate was thus 88.8%. Appendix A presents the demographic information of the respondents. Among the respondents, 43% was male and 57% was female, which means that there was a slight bias towards females. The dominant age groups in this study were between 36 and 55 (75%). All participants were aged over 18 and the age-group between 18-25 was slightly under-represented. Regarding the educational level, nearly 56% had received an academic education, 28% had received a higher vocational education and only 11% had received a post-secondary vocational education.

The survey participants covered a variety of occupations during their work week. The majority of participants was employed (45%), while a smaller part was retired (16%) or unemployed (1%). Other occupations included entrepreneurs (15%), students (9%), volunteers (7%) and

housewife/houseman (5%). With respect to yearly income, 22% of the response group reported an income under €30,000, 25% between €30,000 and €40,000; 32% between €40,000 and €70,000, and 15% reported an income of €70,000 or more.

Regarding the current living conditions of the sample, most of respondents were located in Roodenburgerdistrict (17%), Bos- en Gasthuisdistrict (14%), Leiden-Noord (13%) and Binnenstad-Noord (13%). In addition, 69% of the respondents lived in owner-occupied housing, while 14% lived in private rented housing and 12% in social rented housing. Over half of those surveyed (52%) spent more than 10 years on their current address, 18% spent 5 to 10 years, 19% spent 2 to 5 years and only 9% of the sample spent less than 2 years on their current address. The majority of the respondents were living with a partner (39%) or with a partner and children (29%). The percentage of citizens living alone was 20%, around 8% lived with roommates and 3% of the respondents lived alone with children.

4.1.2. Materials

The survey that was employed to measure the underlying behavioural factors determining textile recycling behaviour consisted of different measurement items for NAM, TPB, intention and demographics. The measurement items for the core constructs of NAM and TPB were adapted from the questionnaires of former studies in light of the two theories. By using prior developed instruments from relevant literature, validity and reliability could be assured since they have repeatedly been assessed on these aspects. All the prospective measurement items were modified or reworded where necessary in order to fit the topic of textile recycling. All items were evaluated based on a seven-point Likert scale ranging from (1) *Extremely disagree* to (7) *Extremely agree* as applied in previous research (Lui et al., 2017; Park & Ha, 2014; Pôskus, 2015; Zhang et al., 2017). Hence, the questions were scaled in such a way that a high score indicated a positive view of textile recycling and a low score indicated a negative view of textile recycling. The seven point scale is considered to be very suitable as it symmetrical and equidistant (Razali et al., 2020). Moreover, it is also recommended by Ajzen (1991) to use for measuring TPB items and additional components. The measure of Cronbach's Alpha α was applied to measure the internal consistency of the constructs as this is commonly used by researchers to assess Likert-scale items (Chianhg, Jhagiani and Price, 2015). The measured items and their accompanying Cronbach's alphas are shown in Table 1.

4.1.2.1. NAM Measures

Measurement items used to measure NAM variables were adapted from previous research on recycling behaviour (Park & Ha, 2014; Wan et al., 2014), waste minimization (van der Werf et

al., 2019), and waste separation behaviour (Wang et al., 2019) in the context of NAM and the integration of NAM and TPB.

To measure the respondent's personal norm of textile recycling, four items were composed: 'I feel morally obliged to recycle textile', 'It would be wrong of me not to recycle my textile', 'I would feel guilty if I did not recycle my textile' and 'Not recycling textile goes against my principles'. Higher scores reflected the respondents higher personal norm. The Cronbach's alpha was high at 0.91.

Four items were summed to measure the degree to which the respondents ascribe the problems caused by textile recycling to their own responsibilities (ascription of responsibility): 'I feel jointly responsible for recycling textile in my daily life', 'I feel jointly responsible for the negative consequences of not recycling textile', 'I feel partly responsible for the environmental pollution and ecological damage caused by not recycling textiles' and 'Everyone must take responsibility for the environmental problems caused by not recycling textile'. A high score showed a larger ascribed personal responsibility.. The Cronbach's alpha was high at 0.92.

To determine the respondent's judgment on the extent to which negative consequences of textile recycling are seen as environmental problems, four items were identified (awareness of consequences): 'Textile recycling reduces the amount of waste that goes into landfill', 'Textile recycling conserves natural resources', 'Textile recycling improves environmental quality' and 'Textile recycling saves energy' A high score indicated a higher awareness of environmental problems caused by not recycling textile. The Cronbach's alpha was high at 0.86.

The following three items were used to measure the degree to which the respondents recognize their own ability to provide relief by recycling textile (outcome efficacy): 'I think I can contribute to reducing environmental impact by recycling my textile', 'I think I can contribute to the reduction of the depletion of raw materials by recycling my textile' and 'Environmental quality will improve when I recycle my textile'. Higher scores indicated a higher personal ability to provide relief to the problem. The Cronbach's alpha was high at 0.92.

4.1.2.2. TPB Measures

Measurement items used to measure TPB variables were selected from previous research on recycling behaviour (Park & Ha, 2014; Tonglet et al., 2004; Wan et al., 2014), waste separation behaviour (Razali et al., 2020; Wang et al., 2019) and environmental complaint (Zhang et al., 2017) in the context of NAM and the integration of NAM and TPB.

The attitude toward textile recycling was measured by asking respondents about six different items, namely textile recycling is “good”, “useful”, “rewarding”, “sensible”, “responsible” and “beneficial for the environment”. High scores indicated a positive attitude toward textile recycling. The Cronbach’s alpha was high at 0.90.

To measure the social pressure to recycle textile (subjective norm), three items were operationalised: “Most people who are important to me have performed textile recycling”, “Most people who are important to me think that I should perform textile recycling”, “Most people who are important to me would approve of me performing textile recycling”. A high score meant a higher experienced social pressure to perform textile recycling. The Cronbach’s alpha was high at 0.80.

Six items were summed to measure the control respondents have over textile recycling and how easy of difficult the performance of textile recycling is likely to be (perceived behavioural control): “I have plenty of opportunities to recycle textile”, “It would be easy and convenient for me to perform textile recycling in the near future”, “I have confidence that if I want to perform textile recycling, I can do it”, “I know what items of textile can be recycled”, “I know where to take my textile for recycling” and “I have enough space to store the materials for recycling”. A higher score meant a high degree of perceived control concerning textile recycling. The Cronbach’s alpha was high at 0.88.

The intention to perform textile recycling was assessed by computing the mean response to the following two items: “I intend to recycle textile in the near future” and “I am willing to participate in textile recycling activities in the future”. Higher scores on this variable reflected a large tendency to perform textile recycling.

4.1.3. Procedure

The initial version of the survey was reviewed by two academics and the municipality of Leiden in order to identify items that might be ambiguous or difficult to answer. As the survey contained human subjects, it was composed in accordance with the guidelines of the Human Research Ethics committee of Delft University of Technology. All participants were adequately informed and provided free consent before filling in the survey. Moreover, all data was protected and anonymised. The survey was considered a ‘minimal risk’ by the supervisors of this research and therefore no further submissions to the Ethical committee were necessary. The survey link was emailed to the members of the Leiden Panel and distributed among my own network as well in order to increase the response rate. Consequently, the participants completed

the survey through Qualtrics. The final survey started with a short introduction, in which the topic and the purpose of the study was briefly explained. Moreover, respondents were told how their responses were used for the study and a consent and privacy statement was given. The final survey continued with questions regarding the demographics and the measurements items for the TPB and NAM constructs, and ended with a thank you message and contact information. In order to increase the response rate, several reminders were emailed to respondents who had not completed the survey yet.

4.2. Results

4.2.1. Descriptive Statistical Analysis

First of all, a descriptive statistical analysis was performed to obtain general information of the NAM and TPB constructs and measurement items. The mean and standard deviation for each predictor is shown in Table 1. Participants reported moderately strong intentions to recycle textile (M = 5.76, SD = 1.28), which shows that people intend to recycle their textile in the future. Moreover, the mean of the attitude construct was high (M = 6.07, SD = 0.88), indicating that the majority of the residents had a positive view towards textile recycling. The means of awareness of consequences (M = 5.72, SD = 1.03), outcome efficacy (M = 5.49, SD = 1.21), ascription of responsibility (M = 5.23, SD = 1.37) and personal norm (M = 5.12, SD = 1.48) were moderate. The means of perceived behavioural control (M = 4.84, SD = 1.36) and subjective norm (M = 4.50, SD = 1.19) were relatively low and just above the neutral score of 4, demonstrating a lower perception of social pressure and perception of ability to perform textile recycling. There are certain items that showed a fairly low mean compared to the other items, namely three items of perceived behavioural control and two of subjective norms: “I know what items of textile can be recycled” (M = 4.18, SD = 1.84), “I have enough space to store the materials for recycling” (M = 4.57, SD = 1.84), ‘I know where to take my textile for recycling’ (M = 4.93, SD = 1.84), ‘Most people who are important to me think that I should perform textile recycling” (M = 4.10, SD = 1.42) and “Most people who are important to me have performed textile recycling” (M = 4.32, SD = 1.43).

Table 1

Measurement items, reliability coefficient and descriptive statistics

Construct	Measurement item	α	Mean	Std. Deviation
Intention			**5.76**	**1.28**
	1. I intend to recycle textile in the near future		5.96	1.36
	2. I am willing to participate in textile recycling activities in the future		5.57	1.50
Attitude		**0.90**	**6.07**	**0.88**
	1. Textile recycling is good		6.48	0.84
	2. Textile recycling is useful		5.79	1.24
	3. Textile recycling is rewarding		5.59	1.33
	4. Textile recycling is sensible		6.33	0.89
	5. Textile recycling is responsible		6.04	1.11
	6. Textile recycling is beneficial for the environment		6.18	0.98
Subjective norm		**0.80**	**4.50**	**1.19**
	1. Most people who are important to me have performed textile recycling		4.32	1.43
	2. Most people who are important to me think that I should perform textile recycling		4.10	1.42
	3. Most people who are important to me would approve of me performing textile recycling		5.09	1.37
Perceived behavioural control		**0.88**	**4.84**	**1.36**
	1.I have plenty of opportunities to recycle textile		4.91	1.67
	2. It would be easy and convenient for me to perform textile recycling in the near future		5.13	1.55
	3. I have confidence that if I want to perform textile recycling, I can do it		5.32	1.50
	4. I know what items of textile can be recycled.		4.18	1.84
	5. I know where to take my textile for recycling		4.93	1.84
	6. I have enough space to store the materials for recycling		4.57	1.84
Personal norm		**0.91**	**5.12**	**1.48**
	1. I feel morally obliged to recycle textile		5.08	1.66
	2. It would be wrong of me not to recycle my textile		5.27	1.57
	3. I would feel guilty if I did not recycle my textile		4.83	1.75
	4. Not recycling textile goes against my principles		5.28	1.65
Awareness of the consequences		**0.86**	**5.72**	**1.03**
	1. Textile recycling reduces the amount of waste that goes into landfill		5.90	1.21
	2. Textile recycling conserves natural resources		5.88	1.19
	3. Textile recycling improves environmental quality		5.66	1.27
	4. Textile recycling saves energy		5.45	1.26
Ascription of responsibility		**0.92**	**5.23**	**1.37**
	1. I feel jointly responsibile for recycling textile in my daily life		5.37	1.52
	2. I feel jointly responsible for the negative consequences of not recycling textile		4.98	1.60
	3. I feel partly responsible for the environmental pollution and ecological damage caused by not recycling textiles		4.98	1.64
	4. Everyone must take responsibility for the environmental problems caused by not recycling textile		5.60	1.35
Outcome efficacy		**0.92**	**5.49**	**1.21**
	1. I think I can contribute to reducing environmental impact by recycling my textile		5.63	1.31
	2. I think I can contribute to the reduction of the depletion of raw materials by recycling my textile		5.63	1.29
	3. Environmental quality will improve when I recycle my textile		5.21	1.33

In order to measure the linear correlations between the dependent variable and the independent variables, the Pearson correlation method was used. This method uses the correlation coefficient *r* to measure the strength of a linear association between two variables. In general, values between *r* = 0.10 - 0.30 show a small strength; *r* = 0.30 – 0.50 medium strength, and values above 0.50 are considered to show a large strength of association (Aerd, 2020). The results of the survey demonstrated that all measurement items had a significant positive relationship with intention, with attitude having the strongest correlation (*r* = 0.62), followed by ascription of responsibility (*r* = 0.57), outcome efficacy (*r* = 0.54), and personal norm (r = 0.52). Meanwhile, the following constructs showed a medium strength: subjective norm (r = 0.47), perceived behavioural control (r = 0.46) and awareness of the consequences (r = 0.44).

Table 2

Correlations between all variables

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Intention	-	.62**	.47**	.46**	.52**	.44**	.57**	.54**
2. Attitude		-	.55**	.49**	.70**	.75**	.67**	.69**
3. Subjective norm			-	.44**	.58**	.36**	.50**	.42**
4. Perceived behavioural control				-	.46**	.47**	.50**	.52**
5. Personal norm					-	.52**	.73**	.56**
6. Awareness of the consequences						-	.55**	.71**
7. Ascription of responsibility							-	.66**
8. Outcome efficacy								-

** = p < .05 level

4.2.2. Factors Influencing Inhabitants' Intentions to Recycle Textile

Consequently, a multiple regression analysis was employed to determine which of the constructs exerted the most influence on textile recycling intention. This comparison was made by analysing the relative contribution of each predictor in explaining the variance towards intention, which is determined by the beta weight (β).

In order to test whether adding NAM variables to the TPB model improved the model fit, a stepwise regression was performed. First, the constructs of TPB (attitude, subjective norm, perceived behavioural control) were entered, and explained 42.4% of the variance in textile recycling intention. After adding the constructs of NAM (personal norms, awareness of consequences, ascription of responsibility and outcome efficacy), the combined model of NAM and TPB explained 45.9% of the variance in intention to recycle textile.

Looking at the several constructs, attitude was the largest significant predictor of textile recycling intention (β = 0.56; $p < 0.001$). Outcome efficacy had the strongest positive

relationship with intention after attitude, and had a marginal significant effect (β = 0.17; p = 0.07). The following predictors had a smaller relationship and marginal significant effect on intention to recycle textile: ascription of responsibility (β = 0.15; p = 0.06) and perceived behavioural control (β = 0.12; p = 0.08). No significant effect on intention was found for awareness of consequences (β = -0.18; p = 0.12), subjective norm (β = 0.11; p = 0.15), and personal norm (β = -0.01; p = 0.87). For further details see Table 3.

Table 3

Results of multiple regression

Construct	B	*t*	Sig.
(Constant)	-0.04	-0.14	0.89
Attitude	0.56	3.64	0.00
Subjective norm	0.11	1.44	0.15
Perceived behavioural control	0.12	1.78	0.08
Personal norm	-0.01	-0.16	0.87
Awareness of the consequences	-0.18	-1.57	0.12
Ascription of responsibility	0.15	1.91	0.06
Outcome efficacy	0.17	1.80	0.07

4.3. Discussion

The survey revealed that participants had a particularly favourably attitude and high intention with respect to performing textile recycling. Moreover, the means of most independent variables were relatively high, demonstrating that the majority of the residents provided positive responses on textile recycling. Furthermore, attitude was also the largest determinant of intention to engage in textile recycling behaviour. Even though the inclusion of both NAM and TPB increased the proportion of explained variances in intention, the addition of NAM only accounted for a small increase. Yet, the construct of outcome efficacy turned out to be the seconded largest predictor of intention, indicating that the combination of the two models increased the predictive power of individuals textile recycling behaviour. Ascription of responsibility and perceived behavioural control showed a marginal significant effect, and therefore reveal some evidence of their influence on textile recycling behaviour. Moreover, examination of specific control beliefs of participants found that items for perceived behavioural control are particularly scoring. This could suggest that residents generally lack knowledge about how to recycle and the container locations, and might not have enough space to store the textiles for recycling.

5. Study 2: Nudging Experiment

As shown in Study 1, citizens of Leiden have a particularly positive attitude and perception of textile recycling. The attitude towards textile recycling also positively relates to citizens intention to recycle textile. Hence, this positive evaluation could imply a high motivation for textile recycling. It is also likely that a fair share of the target audience is already engaging in textile recycling as the intention to recycling is high. According to Schultz (2014), when the target behaviour is relatively easy and the audience is already motivated, informational interventions are appropriate. The respondents also indicated that they lack knowledge about what type of textile can be discarded in the container and the location of the containers. Therefore, the first nudge will include general simplified information and instructions about textile recycling, and is called the 'informational' nudge. This kind of nudge does not fall in one specific category mentioned in the conceptual framework, and can be considered a simplification nudge as it presents specific information about textile recycling in simple and straightforward terms. Due to the fact that the citizens are already motivated, it is predicted that the increase in knowledge will increase engagement in textile recycling behaviour. The following first hypothesis is proposed:

Hypothesis 1 (H1): An informational nudge will significantly increase the amount of household textile recycling in Leiden in comparison to a non-nudge setting.

The second largest predictor of textile recycling intention is outcome efficacy. The effect of outcome efficacy on intention to recycle textile is marginally significant, which might indicate that the higher the perception of outcome efficacy is, the more motivated citizens of Leiden will become to recycle their textile. Hence, outcome efficacy is chosen as the second nudge for the experiment. Important for the 'outcome efficacy' nudge is to provide individuals with information that can increase the extent to which they think their behaviour can contribute to solving environmental problems associated with textile recycling. This type of nudge can be considered as a combination of ecological priming and eco-labelling as it provides information concerning the impacts of textile recycling, and also indicates the gains and losses of (not) recycling textile. As the results of the survey show a positive beta coefficient for outcome efficacy, it is expected that this nudge will increase household textile recycling behaviour in Leiden compared to the condition with no intervention. This leads to the second hypothesis:

Hypothesis 2 (H2): An outcome efficacy nudge will significantly increase the amount of household textile recycling in Leiden in comparison to a non-nudge setting.

5.1. Methodology

5.1.1. Participants and Design

To test these hypotheses, a randomised pre-test post-test control group design was employed, and the unit of randomisation was the textile recycling container. Two treatment groups with each a different nudge and a control group without a nudge were used to investigate the effectiveness of textile recycling nudges. The containers from each district were randomly allocated to either a treatment or control group by using the random number function in Microsoft Excel.

The study ran for 9 weeks, from the beginning of March to the end of May. The pre-test period included 4 weeks prior to the intervention period, and ran from the 1st of March until the 31st of March. The treatment (leaflet) was distributed a month later on the 29th of April. The experimental period commenced several days following the delivery of the treatment so that residents had seen the leaflet and had the occasion to change their behaviour accordingly. The experimental period ran from the 1st of May until the 31st of May. The weights of the containers in the control group were measured in the same way as the weights of the containers in the two treatment groups were measured.

The experiment was performed in four different districts in Leiden. In order to select the districts for the nudging experiment, two aspects were taken into consideration. First of all, the experiment had to take place in a neighbourhood that represented the population of the survey participants. In addition, neighbourhoods that yielded a moderate to low amount of textile each month were chosen as they have the most potential to be improved according to the municipality of Leiden (2020). The results of the survey indicated that most of the respondents are located in Roodenburgerdistrict (17%), Bos- en Gasthuisdistrict (14%), Leiden-Noord (13%), Binnenstad-Noord (13%), Merenwijkdistrict (12%), and Stevenshofdistrict (12%).

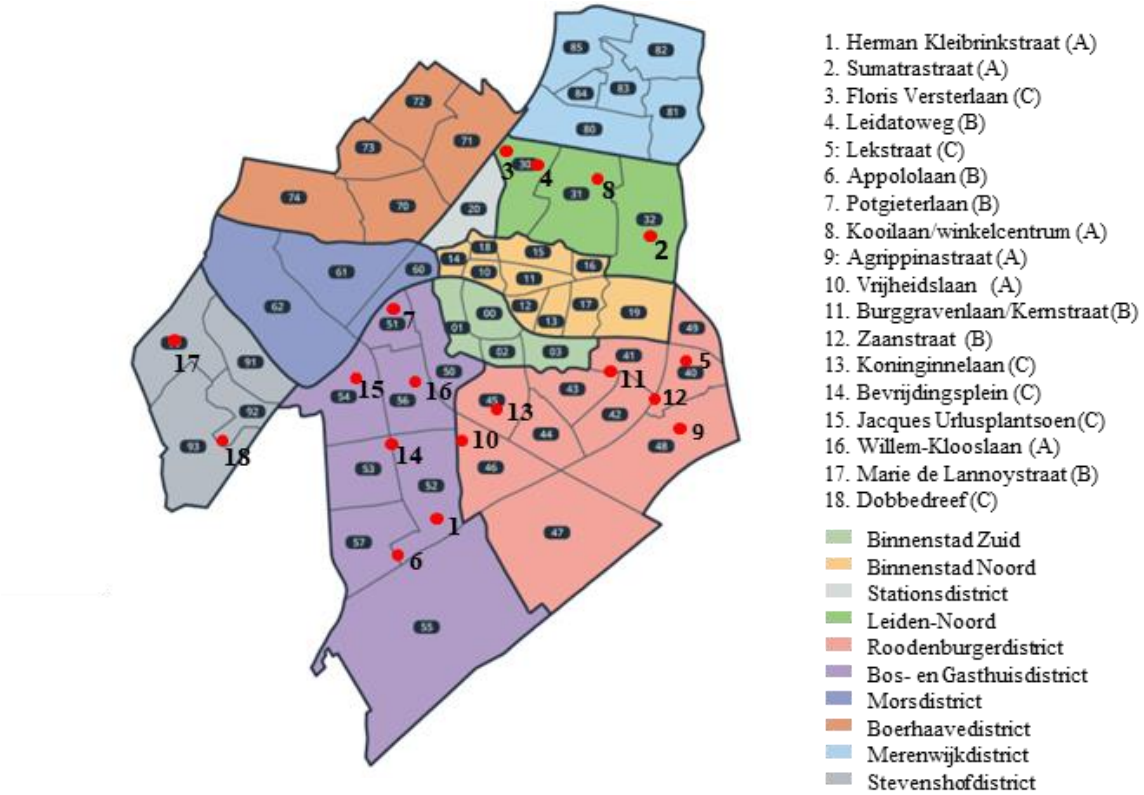
Data provided by the municipality showed that in March the highest amount of textile collected by a container in March was 2495 kg, while the lowest amount was only 35 kg. Containers that yielded an amount of textile lower than one fourth of the total were considered, hence all containers under 623.80 kg of textile in March were eligible. In order to match the population of the survey, only the districts mentioned above were looked into. Finally, in consultation with the municipality and academic professionals, the following districts and containers were chosen: six containers from Bos- en Gashuisdisctrict, six from Roodenburgerdistrict, four from Leiden-Noord and two from Stevenshofdistrict (Van der Plas, 2020) (Figure 5). In order to ensure an equal distribution of each district in each of the 3 groups, each group had at least 2

containers from Bos- en Gashuisdisctrict, 2 from Roodenburgerdisctict and 1 from Leiden-Noord and 1 from Stevenshofdistrict. One group had 2 containers from Leiden-Noord as choosing another container from Stevenshofdistrict was not possible due to the high amount of textile in the remaining containers in Stevenshofdistrict. Moreover, choosing 6 containers from only Leiden-Noord was also not possible as other containers in the district had more than the threshold of 623.80 kg of textile. The containers of each district were randomly assigned to each group. The locations of the containers as well as the division of the groups can be found in Figure 6.

In total, 50 households located in close proximity to each container were selected to receive the nudge. In all cases, the distance from the textile recycling container to the households was at most 150 meters. According to the municipality, within this distance it can be assumed that the residents go to the container in question instead of another container in the district which is not measured in this experiment. The households were not aware that they were participating in an experiment.

Figure 6

Location of the containers used in the current study



Note: (A) = treatment group A, (B) = treatment group B, (C) = control group.

5.1.2. Materials

Both nudging interventions in this study used leaflets with written information and visuals that were designed to encourage and remind households to recycle their textile, thereby discouraging textile entry into residual waste bins. All information on the leaflets was presented in a vivid and tangible manner, in order to increase the probability that the message will be remembered and attended to (Gonzales et al., 1988; McKenzie-Mohr, 2013). The informational nudge focused on the How-information in the form of sorting instructions and the location of the nearest recycling container in order to address the knowledge barriers (Figure 7). Even though all relevant and important information might be publicly available, many individuals do not use this information when making decisions due to attention limitations. Therefore, this nudge provided important information in an easily accessible manner, thereby hoping to overcome these attention limitations (Damgaard & Nielsen, 2018). The information was largely adapted from the website of the municipality of Leiden (2020) about textile recycling, and included additional simplified information from Sympany (2020) and Milieucentraal (2020) in order to support better active decision-making. Making key information more salient – visible - for the individual is important as it increases the likelihood of influencing behaviour (Lehner et al., 2016). Therefore, the information about the location of the nearest container and the type of clothes that can be recycled was also made more salient by adding visuals. This information is considered important since awareness about these aspects could make textile recycling easier for residents.

The outcome efficacy nudge included information about the impacts of textile recycling, the current recycling rates and how much greenhouse gasses can be reduced by recycling textile (Figure 8). It also described the textile recycling process and what happens to the textile after collection. It was of particular importance that the leaflet contained information about the difference an individual can make by participating in textile recycling. Therefore, data was included concerning the amount pollution produced per citizen per year by not recycling their textile, and the amount of CO2 that could be avoided by the population of Leiden if everyone would recycle their textile. For example, the amount of CO2 was highlighted in the leaflet as follows: "*If every person in Leiden would separate their textiles, more than 4.3 million kg of CO2 could be saved per year"*. The specific information regarding the emissions and pollution was made more salient by increasing the font and using different colours, thereby making it more visible for the individual. Thus, Why-information was emphasized in this leaflet, with the clear objective of using environmental gains as motivational factor for households. The

following literature was used for this leaflet: Eureco (2010), Gemeente Leiden (2020), Sympany (2020).

The initial design for the leaflets was developed by the author of this paper, after which the graphic design team of the municipality incorporated two logos of the municipality and changed the font. Both leaflets had the same lay-out and used the same colour scheme, to ensure that there was only a difference in information content between the leaflets. The leaflets were A4 (29.7 x 21 cm) in size and could fit in the mailboxes of households. All information was checked by Sympany and the municipality of Leiden before distribution. As the experiment contained human subjects, it was also composed in accordance with the guidelines of the Human Research Ethics committee of TU Delft. All data was protected and anonymised. The experiment was considered a 'minimal risk' by the supervisors of this research and therefore no further submissions to the Ethical committee were necessary.

5.1.3. Procedure

For the distribution, one volunteer as well as the author delivered 600 flyers to the selected households through their letterbox. Treatment group A received the outcome efficacy nudge, treatment group B received the informational nudge and the control group did not receive any nudge. The routes were planned in advance to ensure that the leaflets could be delivered to the households using the least amount of staff effort.

Weights from separately collected textile were registered by the municipal collection services trucks at each textile recycling container with an accuracy of ± 10 kg. Weights were measured for all 18 containers at one to four occasions over the last four weeks prior to the intervention. Weights were also measured at four occasions over the last four week after the intervention

Figure 7

Informational leaflet

Figure 8

Outcome efficacy leaflet

5.2. Results

An one-way ANOVA was used to determine whether there are any statistically differences in the amount of collected textile between the two treatment groups and the control group. The same containers were measured twice (pre- and post-measurement) in order to identify changes to the intervention. Results from weightings of separately collected textile over the weeks before as well as the period after the intervention are displayed in Table 4 and 5. In order to conduct the one-way ANOVA, the difference between the second measurement and first measurement was used for the analysis. The outcome variable was found to be normally distributed and variances were assumed to be equal based on the results of Levene's test $F(2,15) = 0.14$, $p = 0.87$) (Appendix B).

Comparing the average amount of separately collected textile over the 4 weeks before and the 4 first weeks after intervention, the mean weight of textile collected in treatment group A increased by 80%, from 226.67 kg (*SD* = 142.43) to 407.50 kg (*SD* = 250.02). In treatment group B, the mean weight of textile increased by 65%, from 263.33 kg (*SD* = 96.42) to 435.00 kg (*SD* = 132.59). In the control group, the mean weight increased by 49%, from 305.00 kg (*SD* = 135.68) to 462.50 kg (*SD* = 193.15). However, the results of the one-way ANOVA indicated no statistically significant differences among the three conditions regarding the collected textile ($F(2,15) = 0.46$, $p = 0.64$). Therefore, no further post hoc analysis was conducted.

The descriptive analysis revealed that within groups standard deviations were high, indicating that the data are very spread out around the mean. The standard deviation was especially high in treatment group A and the control group during the post-measurement. This reflects a large amount of variation in the groups that are being studied. Moreover, the specific data per container revealed that there are a number of large outliers (Table 5). In particular, container 7 showed a very high percentual increase of 571% after the introduction of the intervention, while the other containers in the group stayed under a 100% increase. In all three conditions there was at least one large outlier, which could have had a significant effect on the mean and standard deviation of the three conditions.

5.3. Discussion

Study 2 used the findings of Study 1 to design two nudging interventions and test these in a real life context. The results showed that even though both treatments groups experienced a larger percentual increase than the control group, there was a lack of statistical evidence on the effect of nudges.

This means that both hypothesis 1 and 2 are not supported: both the outcome efficacy nudge and the informational nudge did not significantly increase the amount of textile collected in the treatment groups compared to the control group.

Table 4

Mean weights (kg) and standard deviations for each condition and time period

Condition	**Pre Measurement**	**Post measurement**	**Increase (%)**
1. Control	305.00 (135.68)	462.50 (193.15)	48.91%
2. Treatment A	226.67 (142.43)	407.50 (250.02)	79.78%
3. Treatment B	263.33 (96.42)	435.00 (132.59)	65.19%

Table 5

Weights (kg) per container

Condition	**Container**	**Pre measurement**	**Post measurement**	**Increase (%)**
Control	**1**	105.00	240.00	128.57%
	2	175.00	505.00	188.57%
	3	345.00	605.00	75.36%
	4	350.00	590.00	68.57%
	5	400.00	200.00	-50.00%
	6	455.00	585.00	28.57%
	Total	**1830.00**	**2725.00**	**48.91%**
Treatment A	**7**	35.00	235.00	571.43%
	8	80.00	100.00	25.00%
	9	265.00	375.00	41.51%
	10	280.00	380.00	35.71%
	11	285.00	535.00	87.72%
	12	415.00	820.00	97.59%
	Total	**1360.00**	**2445.00**	**79.78%**
Treatment B	**13**	175.00	225.00	28.57%
	14	190.00	445.00	134.21%
	15	190.00	520.00	173.68%
	16	290.00	610.00	110.34%
	17	315.00	450.00	42.86%
	18	420.00	360.00	-14.29%
	Total	**1580.00**	**2610.00**	**65.19%**

6. General Discussion

The aim of the present study was to investigate the real-world effectiveness of using nudges to encourage household textile recycling behaviour. The methodological framework of Steg and Vlek (2009) was applied to this study since behavioural interventions are considered to be more effective if they are systematically planned, implemented and evaluated. Therefore, this study followed the four steps of the framework and consisted of two parts, namely a survey and an experiment, which both used the municipality of Leiden as a case study. As far as the author is aware, this is the first study that used the framework of Steg and Vlek (2009) to promote textile recycling behaviour, in addition to the first study that implemented nudging interventions to increase household textile recycling behaviour.

The first part of this thesis focused on the examination of the main factors underlying textile recycling intention (Study 1). The survey revealed valuable insights into the perceptions of residents in Leiden. Regarding the models that were used for the survey, the TPB model (attitude, subjective norm, perceived behavioural control) explained 42.4% of the variance in intention to recycling textile. The percentage of variance explained increased to 45.9% when the NAM (personal norm, ascription of responsibility, awareness of consequences, outcome efficacy) was also included. This is higher than the variance reported for pro-environmental textile disposal intention in the model of Stols (2016), which was 30%. Yet, it is important to note that his study only focused on females and also included two different types of intention in addition to intention to recycle textile, namely the intention to donate and the intention to resell. Hence, the importance of the determinants of intention might vary depending on the context of the study or type of behaviour studied. Nevertheless, adding the NAM to the TPB model increased the total explained variance in textile recycling intention. The results are therefore also in line with the findings of Park and Ha (2014) and Setiawan et al. (2020), who demonstrated that the combination of the two models increases the theories explanation power of pro-environmental behaviour.

The combination of TPB and NAM proposed two main determinants of textile recycling intention, namely attitude and outcome efficacy. Attitude was found to be the largest predictor. Certainly, residents will not participate in textile recycling unless they perceive these programmes and outcomes as favourable. This result is in accordance with Stols (2016), who also found that attitude had the strongest influence on intention to dispose textile in an eco-friendly manner. Moreover, the findings demonstrated that residents of Leiden, in general,

already have a favourable view of textile recycling. Therefore, the challenge for the municipality is to reinforce these positive attitudes in residents and influence the attitudes of residents who currently view textile recycling negatively. The second largest predictor was outcome efficacy, which shows that there is also evidence that residents are more likely to recycle their textile when they believe that their behaviour can contribute to reducing environmental problems caused by not recycling textile. The findings also reveal that certain items from perceived behavioural control are scoring low. Residents are particularly lacking knowledge on how to recycle and knowledge about the container locations. Especially for residents who are not yet recycling their textile, these factors are important to take into account as they can explain their current non-recycling behaviour.

The behavioural insights identified in Study 1 laid the foundation for Study 2. First, two different nudging interventions were designed, the informational nudge and the outcome efficacy nudge. The informational nudge was designed to address the favourable attitude towards textile recycling of citizens and the two knowledge barriers identified in the survey, and consisted of general information about textile recycling. The outcome efficacy nudge contained information about what difference an individual can make by participation in textile recycling to address the specific predictor.

The next step was the execution and evaluation of the implementation of the nudging intervention by doing a field experiment. It was predicted that higher weights of textile would be collected in both the informational nudge and outcome efficacy nudge setting compared to a non-nudge setting (H1 and H2). The results show that both treatment groups experienced a larger percentual increase than the control group: the outcome efficacy nudge group increased by 80% and the informational nudge group increased by 65%, while the control group increased by 49% after the introduction of the intervention. However, the results show no statistically significant support that the informational nudge or outcome efficacy nudge increased the recycling of textile in Leiden. Therefore, both hypotheses were not supported. These findings are contradictory to previous studies that investigated the effectiveness of recycling nudges. For example. Shearer et al. (2017) and Linder et al. (2018) used information leaflets to increase food waste recycling, and both found a significant increase in the treatment group.

Even though both hypotheses were not supported, this research has several strengths. The main strength lies in the practical implications for the municipality and its ecological validity. As delivering insights to the municipality was one of the main objectives of this study, the survey especially provided important antecedents and barriers of textile recycling behaviour. The

survey results are considered to be representative of the population of Leiden as the Leiden Panel was used, and are therefore considered to be valuable input for the municipality. Moreover, conducting a field experiment allows testing the intervention in a natural setting, compared to an artificial environment in a laboratory experiment. Hence, the study is more likely to reflect real-life which increases its generalizing ability. The disadvantages related to a field experiment were kept to a minimum by including randomisation and a control group (Keizer et al., 2013).

However, some important limitations might explain the lack of a significant increase in textile recycling behaviour. First and foremost, due to limited resources the nudging experiment and the survey were contained to a small sample size. A small sample size makes it more difficult to determine if the outcomes were an accurate finding. In addition, the small sample size decreases its representability of the entire population of Leiden and lowers the statistical power of the analyses. Especially the results of the experiment show high variability since the standard deviation within conditions is high. The data is thus widely spread which causes it to be less reliable. Moreover, the analysed containers in the sample had a few large outliers, and due to the small sample size the results are more sensitive to these outliers and more easily affected by them.

Another notable finding of the experiment is the large increase of discarded textile in the containers in May compared to March. A possible reason for the large increase in the treatment and control groups could be related to the timing of the nudging intervention. Textiles are often only discarded on certain occasions, such as an annual or seasonal cleaning out. This means that the change from spring to summer could have led to a rise in clothing disposal as people usually discard old summer clothes before buying new clothes for the season. Moreover, at the end of April the COVID-19 lockdown measures eased in the Netherlands, which allowed clothing stores reopen and people to go shopping again. This also could have caused people to check their wardrobe and to discard old or ‘unfashionable’ clothes. Another limitation is therefore that the subjects in this study were studied for a short period. The experiment had two time measurements, 4 weeks before the intervention and 4 weeks after the intervention, resulting in few data points for the analysis which also made it more sensitive to large outliers.

Regarding the leaflets, there is a possibility that not all leaflets reached the target audience. For example, some citizens who received the leaflet might have regarded them as junk mail, and immediately discarded it before reading. In addition, women tend to more environmentally friendly and are usually also the principle decision-makers in the household regarding clothing

(CBS, 2021; Solomon, Russell-Bennet & Previte, 2013). Therefore, if the nudge reach the person who is in charge of textile discarding, it might not result in the desired behaviour. It might also be the case that citizens who read the leaflet donated their textiles to a charity or discarded their textile in another recycling container than the container that was measured. For instance, residents might have been encouraged by the leaflet to recycle their textile, yet decided to bring their textile to non-profit organizations such as the Salvation Army or Goodwill as this is still often the most commonly used method for disposing of textile (Goudeau, 2012).

Lastly, although the survey provided important insights about the determinants of textile recycling behaviour, some aspects should be considered. Especially the importance of testing and adapting interventions to a local context and target group should be highlighted. As the survey measured the perceptions of residents of Leiden, it restricts the extent to which the results can be generalised to other cities in the Netherlands. Several additional studies should be conducted throughout the Netherlands before interventions could be planned for the whole population. Most of the findings are highly contextual, and the facilitators and barriers found in Leiden might not apply to other parts of the Netherlands. For instance, people living in urban areas are generally more concerned about the environment than people living in rural areas (CBS, 2021). Therefore, urban dwellers might be more knowledgeable about textile recycling. People in more rural parts of the Netherlands might also not have textile recycling containers nearby compared to people living in cities. This means that it will take more effort for those people to recycle and other strategies might fit better in these areas, such as door-to-door collection. Hence, it is important that the specific attitudes per region are investigated and tailor-made nudging interventions are developed.

Nevertheless, although the results of the nudging intervention were not statistically significant, the potential of this intervention should not be dismissed but should instead motivate further research. The nudges did increase the mean weights of both treatment groups compared to the control group. Therefore, the logical next step for the municipality of Leiden would be a larger-scale implementation of the nudging intervention. As the framework from Steg and Vlek (2009) used in this study is rather straightforward, it allows for easy replication by the municipality or other interested parties. The future study should include more textile recycling containers and should hand out more leaflets to households living close to the containers. Since the current intervention was rather small scale, conducting it on a larger scale could yield more reliable and significant results.

To account for the seasonality and the lack of data points, the new study should also examine the long-term effects of the nudging intervention. Since a large increase is measured in May, it would be interesting to find out if this increase would persist in the following months (e.g. six to twelve months). As nudging can have a powerful influence on behaviour, the long-term analysis of data can offer valuable insights, which will also allow municipalities to modify the intervention to achieve the desired results (Gonçalves et al., 2021).

In addition, it could also be valuable to test other types of leaflets or add another treatment group that receives both the informational and outcome efficacy leaflet. In order to counteract the limitation of the leaflet not reaching the target audience, leaflets could also be handed out multiple times, or could be combined with another intervention such as a sticker prompt on a textile container which could work as a reminder. Furthermore, doorstepping or a short follow-up questionnaire can also be incorporated in future studies in order to assess citizen's perception of the leaflet and the degree to which it was actually received and understood.

The findings of the survey could also have important implications for textile recycling schemes and future awareness campaigns. Even though the nudging intervention did not provide sufficient evidence of their effectiveness, the results of the survey indicated that residents lack knowledge about textile recycling. Therefore, it would still be valuable for the municipality to design new textile recycling schemes provided with clear instructions as to where the containers are and what can be put in the containers.

Lastly, regarding the ethical criticisms, acceptance by the general population is a key consideration for interventions based on behavioural insights such as nudging. This generally depends on the ends that are pursued, and social norms and values play a role. As pro-environmental ends are usually accepted by the public, nudging interventions aimed at increasing textile recycling behaviour are assumed to be less controversial. In addition, interventions that merely change how information is presented, such as simplification of enhancing the salience of certain items are less controversial compared to e.g. defaults. Since both the informational as well as the outcome efficacy leaflet are also presenting their information in this way, is it easier for these interventions to gain acceptance. Thus, since the nudging intervention could be considered fair and straightforward, in addition to being inexpensive to adapt, scale-up and repeat, it makes sense to not disregard this intervention at once.

7. Conclusion

Our current resource-wasting textile industry is under enormous pressure to achieve more circularity, which would enable clothes to recirculate to new consumers and unusable textiles to be recycled into new products. The circular targets set by the European Commission present a serious challenge to the Netherlands since the majority of end-of-life textiles are currently incinerated as they end up in residual waste containers. Individuals can make a substantial contribution to the long-term sustainability of the textile industry by adopting more pro-environmental behavioural habits, of which textile recycling is one.

This study investigated the effect of two different nudging interventions aimed at increasing household textile recycling behaviour through a case study in Leiden. An online survey among residents provided the input for the design of the nudging interventions. Two different leaflets were distributed amongst households, one leaflet focused on the How-information while the other emphasized Why-information regarding textile recycling. The findings show that both nudging interventions did not result in a significantly increased amount of textile collected for recycling. However, this study may provide a solid basis for further research into encouraging textile recycling behaviour. The results of the survey add to the existing literature by demonstrating the power of combining the two models of TPB and NAM to study pro-environmental behaviour. Furthermore, as textile recycling behaviour has not been studied much, this study delivers important insights into the perceptions of residents, which could be valuable for municipalities or governments.

Despite the relatively inconclusive outcome of the nudging interventions, the use of nudges is growing around the world. Nudges seem to be powerful interventions to encourage more sustainable behaviour in society. Considering the high adaptability and the low cost involved in the execution of nudges, these interventions could be economically sound strategies for municipalities and governments. The largest promise of nudges is perhaps in the fact that they are easy to implement and target behaviours that cannot be tackled by other policy tools as they affect automatic and unconscious decision making. Nudging should therefore be regarded as a useful addition to policy toolkit in order to promote pro-environmental behaviour. Repeating the field experiment on a larger scale would be the natural next step before textile recycling nudges can be dismissed as an intervention. Yet, as noted before, nudging should be used in combination with traditional policy instruments, and not function as a replacement. It should not be seen as a silver bullet solution to the current environmental problems. Merely

concentrating on encouraging people's pro-environmental behaviour will not result in the large-scale transformation required. As a result, behaviour change must be integrated and operationalized across sectors, organizations, policies, and individuals.

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Appendix A

Table A

Demographic attributes

Variable	Category	%
Gender	Male	43%
	Female	57%
	Other	0%
Age	<18	0%
	18-25	12%
	26-35	29%
	36-45	37%
	46-55	38%
	56-65	30%
	65+	30%
Education	No education	0%
	Middle school	1%
	High school	3%
	MBO	11%
	HBO	28%
	WO	56%
	Other	2%
Occupation	I am employed	45%
(multiple answers possible)	I am an entrepreneur	15%
	I am unemployed, looking for a job	1%
	I am retired	16%
	I study / go to school	9%
	I am a housewife / houseman	5%
	I volunteer	7%
	Other	3%
Income	<€30.000	22%
	€30.000 - €40.0000	25%
	€40.000 - €70.000	32%
	>€70.000	15%
Residential location	Binnenstad-zuid	9%
	Binnenstad-Noord	13%
	Stationsdistrict	2%
	Leiden-Noord	13%
	Roodenburgerdistrict	17%
	Bos- en Gasthuisdistrict	14%
	Morsdistrict	5%
	Boerhaavedistrict	4%
	Merenwijkdistrict	12%
	Stevenshofdistrict	12%
Type of dwelling	Owner-occupied housing	69%
	Social rented housing	12%
	Private rented housing	14%
	Other	2%
Time spent on current address	< 2 years	9%
	2 - 5 years	19%
	5 - 10 years	18%
	> 10 years	52%
Type of household	Living alone	20%
	Living alone with children	3%
	Living with a partner	39%
	Living with a partner and children	29%
	Living with roomate(s)	8%

Appendix B

Table B

One-way ANOVA results

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.747[a]	2	0.874	0.464	0.638	0.058
Intercept	17.701	1	17.701	9.394	0.008	0.385
group	1.747	2	0.874	0.464	0.638	0.058
Error	28.264	15	1.884			
Total	47.712	18				
Corrected Total	30.011	17				

a. R Squared = .058 (Adjusted R Squared = -.067)

Test of Homogeneity of Variance

	Levene Statistic	df1	df2	Sig.
Based on mean	0.1369	2	15	0.873
Based on median	0.0920	2	15	0.913
Based on median and with adjusted df	0.0920	2	10.297	0.913
Based on trimmed mean	0.1190	2	15	0.889