The Concept of Nudging in Landscape Architecture and Planning: Understanding Nonconscious Human-Environment Interaction in a Natural Context

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Master Thesis

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ABSTRACT

In order to direct behaviour in public space, a multitude of instruments is currently available. A relatively new instrument is the nudge, as coined by Thaler and Sunstein in 2008. They suggest that most decisions are nonconscious, and starting from this rationale the common regulatory instruments are inefficient since they address the rational, reflective areas of the mind. Instead, they propose to influence behaviour through nonconscious cues in the design of the physical environment. Although the concept is adopted by policy-makers, it is still unclear how nudges function, and the concept has not been scientifically tested. Therefore, the aim of this thesis is to investigate how nudging can be employed as a spatial instrument to steer nonconscious behaviour in public space. Based on a literature review, a field experiment is used to examine if a spatial intervention affects behaviour of individuals on the Wageningen University campus. Using a chi-square test, it is determined that the intervention does indeed influence behaviour. This is in line with the expectations grounded in the literature review.

PREFACE

This thesis is submitted to the Cultural Geography group at Wageningen University in partial fulfillment of the requirements for the degree of Master of Science in Landscape Architecture and Planning, specialisation Social-Spatial Analysis of Sylvia Neutel. Before commencing, I would like to start with a personal note on my motivation for studying this subject and my experience of the thesis' process.

Understanding human behaviour in space is vital in developing effective plans and designs within the landscape architecture and planning domain. During my study programme, insights into this behaviour have been covered in different courses, where the topic already attracted my attention during the first years of the bachelor. I felt this was a topic I wanted to investigate in more detail, and therefore I took the opportunity to explore it during my MSc thesis. I was extremely interested in what made people behave in certain manners, what leads them to make spatial decisions, and how this topic can be applied. I hope the work that I have performed will help me to put environmental and behavioural psychology into practice within the field of landscape architecture and planning.

During the completion of the thesis I have thoroughly enjoyed studying the topic but times have also been tough. Many people view writing an MSc thesis as the pinnacle of higher academic education, and the importance of the thesis work is reflected by the prominent role it takes within the whole MSc program. After completing four years of courses in the educational program, the thesis has challenged me to set up and carry out a scientific research project in an almost fully self-responsible manner. The project has been an individual learning process as well as an educational activity. The pressure of delivering a result that would satisfy my own standards as well as the university's standards got to me every now and then, but thanks to my friends, parents, Maarten, and a little perseverance I always got over it. Thanks!

I think I've developed a broader range of skills during the thesis than only substantive, content-related knowledge. I have developed competencies of independency, dealing with setbacks, confidence and tenacity, and work ethics and planning. These competencies will hopefully aid me during my internship and after graduation, and I am looking forward to each and every one of these experiences.

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READING GUIDE

This document, created in the context of the GEO-80436 MSc Thesis Cultural Geography course at Wageningen University, presents the master thesis in the Landscape Architecture and Planning programme of Sylvia Neutel. This thesis investigates how the concept of nudging can be employed to create a new set of behaviour steering instruments. The literature review culminates in a conceptual model that explains how nudging works. Furthermore, the employs an empirical study in order to tentatively demonstrate the applicability of the model to the real world.

The thesis commences with an introduction, outlining the current situation leading up to the problem statement. In the problem statement, the motivation for the selection of the topic is outlined. Thereafter, the scientific objective is set forth. The scientific objective presents the main goals of the thesis. The first chapter also addresses the historical and scientific background of the subject, and the relevance of the subject. The second chapter delineates the literature review. Important theories related to the main topic are presented, and their influence towards the thesis objective is demonstrated. Thereafter, the methodology and data analysis design are elaborated upon. They describe how the experiment will be performed and how the resulting data will be processed. Finally, the results of the literature review and the empirical study are presented and discussed.

01. INTRODUCTION

It's a slightly arresting notion that anything you do is essentially constrained by the configuration of your immediate surroundings. Enter that room? There's the door. Want to sit down? Use the chair right there. Grocery-shopping? The supermarket is only 5 minutes by bike. Visit grandma? Highway A12 will take you straight there. Although it's theoretically possible to smash through the wall, sit on the floor, or bump through meadows and ditches to reach whatever destination you have in mind, that won't be particularly convenient or painless. It becomes even more frightening when you realise that therefore, every move you make is almost certainly influenced by someone. The design of your everyday surroundings lies in the hands of the architect, the politician, and the construction-worker. Your behaviour is completely confined within the boundaries of your environment.

For a long time it puzzled me how something so everyday and ordinary could determine our lives to such extent. And no one even realises it. Then it got me wondering. Was it possible to exploit this realisation in my planning and design? *Nudge* by Thaler and Sunstein (2008) opened my eyes to the potential of applying behavioural psychology in the design of the landscape. Thaler and Sunstein propose to "nudge" people into making certain decisions through the design of their physical environment. Starting from the assumption that most decisions are made nonconsciously and therefore most behaviour is irrational, they argue that common regulatory instruments, such as legislative, financial, or discursive incentives, won't be sufficient if we want to improve people's everyday life. Thus, it sets itself apart from these commonly used, coercive instruments because it aims for non-forced compliance. A nudge, as they define it, is any aspect of the environment that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives. The concept of nudging argues that positive reinforcement and indirect suggestions can influence the motives, incentives, and decision-making of individuals, thus altering their behaviour.

This chapter elaborates upon the problem statement, context, the scientific objectives, and the research questions. Thus, it also sets forth the relevance of the proposed study. It characterises the research project and includes a brief outline of the structure of the subsequent chapters and how they work together to support the main thesis argument, which is set forth below.

01.1 PROBLEM STATEMENT

It is strictly necessary to regulate behaviour in public space, in order to counter non-social, unsafe or aggressive behaviour. From a societal perspective, some problems, such as compliancy in traffic, misbehaviour in public transport, crime in neighbourhoods or sustainable energy use, can only be solved when behaviour change is achieved in the public domain.

In the currently prevailing typology, either legislative, financial, or discursive strategies are commonly adopted in order to influence citizens' behaviour. Legislative strategies towards behaviour change typically include the implementation of laws and the policing and sanctioning of those who do not adhere to the law. Financial strategies include fining, taxing and subsidising to provide an incentive towards specific behaviour. Discursive strategies use information to raise more awareness about specific topics, guiding citizens towards a certain behaviour (Fenger and Klok, 2008; Peeters and Schuilenburg, 2014).

However, current instruments in spatial planning and design are based on a rational choice model, whilst nonconscious choices are considered more and more important. At present, there are no instruments available that address this behaviour. The concept of nudging can saturate this gap. Nudging affects the daily routines and choices of citizens in a completely different manner and focuses on the increasing awareness of the importance of nonconscious choice processes. Humans do not always make perfectly rational decisions, as their decision-making can be biased. Nudging addresses these nonconscious decisions and the resulting behaviour, as it can aid their decision-making process by steering automatic behaviour, without specifically restricting options.

The concept of nudging has become a beloved phrase used by policy-makers explaining how they wish to design future environments. Still, there are many ambiguities when applying this concept in a spatial context. Nudging is not scientifically substantiated, although Thaler and Sunstein have indicated that they expect the concept to work in spatial applications and they give several examples. However, they haven't provided a theoretical framework indicating how they suspect this works, and neither have they tested it in practice. Other research may provide more scientific evidence of how the concept of nudging, which appears to work in practice, functions theoretically. Moreover, empirical testing could substantiate the claims that are currently made. Therefore, additional research is necessary.

A better understanding of nudging can create the possibility to devise new steering instruments. As argued, nudging is a current and popular concept in both scientific writing and policy, but it is still unclear exactly how the concept functions when it comes to spatial interventions. In this context,

nudging is poorly understood. The concept is often illustrated with examples, but its functioning has not been scientifically investigated. This knowledge deficiency is significant because not knowing about this topic will create poorly designed environments. Also, a better understanding of nudging will create a whole new group of potential interventions that can be applied in spatial planning and design. Right now, the theories remain on an abstract level and the application of their concepts do not correspond well between authors. Current theories about behaviour change have not been specifically applied in a spatial context, even though the importance of the physical environment is always stressed. Theoretical claims that combine the influence of the physical environment on automatic behaviour are fragmented and no coherent framework exists. This is a sign of a theoretical field that is still in an early development stage. The concept of nudging has been coined in 2008, and therefore it's one of the most recent theories in this field. Compared to other fields of psychology the discipline dealing with environment and behaviour is relatively new, and therefore may be lacking a strong theoretical foundation in some sections (Baroni, 2003; Nagar, 2006). To further enhance understanding of nudging, it is important to clarify the underlying theoretical assumptions about how these types of interventions work (Steg et al., 2013). This will solve the existing lack of definitional and conceptual clarity and can serve as a basis for empirical testing of the concept of nudging. These problems have defined the rationale for this thesis, namely (1) a need for theoretical development in the functioning of nudging, by connecting the concept to scientific literature on nonconscious processes and decision-making, and (2) its application through empirical study, in order to demonstrate that the concept will function in a natural experiment.

Ultimately, the question is how nudging can be employed in order to steer nonconscious behaviour in public space. It is still unclear how the design of the physical environment can contribute to more normative behaviour in the public realm. Scientific theories on nonconscious behaviour provide guidelines, but they have not been explicitly applied in the Dutch public space, even though this wish is specifically expressed by policy-makers. Therefore, in the present research, the possibility is explored that the design of everyday, inanimate objects can serve as nudges that exert automatic, nonconscious effects on behavioural choices. Thereby, environmental design may have the potential to solve societal problems in public space.

In summary, governments are realising the potential of nudging interventions in order to solve societal issues in public space, and express the desire to implement these into their array of instruments. Several institutions have communicated the wish to explore nudging in their policies. Scientific authors also acknowledge the potential of nudging to steer behaviour in public space, but they often mention examples and do not elaborate upon the theoretical underpinning of the spatial implementation of the concept. Still, it is apparent that nudging has the potential to create a whole

new array of instruments that can be employed in spatial planning and design, targeting nonconscious behaviour rather than the rational instruments that are currently used.

Therefore, the main research question of this thesis is:

- How can nudging be employed as a spatial instrument to steer nonconscious behaviour in public space?

To answer this main research question, several sub-questions have been defined, namely:

- How do humans make decisions about behaviour?
- Does the literature on nonconscious decision-making support the premise of the concept of nudging?
- Can nudging be applied to steer behaviour in public space?

01.2 CONTEXT

From the problem statement, it has become obvious that behaviour in public space needs to be regulated. Nudging may provide an alternative to coercive strategies that applied at the moment. It has been argued that more research into the concept of nudging is necessary. However, historical developments, as well as the presence of nudging in policy and science, may provide preliminary knowledge. These subjects are explored in the subsequent paragraphs.

01.1.1 HISTORICAL DEVELOPMENT

Formerly, the term social engineering was used to indicate the belief that society could be constructed in the same manner in which technical engineers construct physical surroundings. The predominant belief in this type of environmental determinism led to the idea that the physical environment predisposes and directs human social development. This means that arranging and channelling environmental and social forces will create a high probability that effective social change will occur (Alexander and Schmidt, 1996). However, over the last decades people have been becoming increasingly sceptical about the philosophy of social engineering, and the pursuit of a society that is methodically planned and organized.

Very recently, a new interest in this subject has emerged. However, the philosophy of social engineering has been contested as an aggressive and disastrous belief, because there is a growing

awareness of the limits of social engineering and our understanding of society. It is realised that the agency or free will of human beings plays a large part in their decisions as well (Boomkens et al., 2008) and these realisations are explored. Ecological theories consider the environment-behaviour relationship as bi-directional and interdependent entities. The idea of social engineering shifted into more subtle methods of behaviour change, namely through affecting choices made in the landscape using the environmental context. It is realised that a great deal of human functioning is rooted in nonconscious processes, which can be activated through the environmental context. People respond behaviourally and perceptually to the detailed design of public space (Zacharias, 2001).

Responding to these developments, Thaler and Sunstein applied the environment as a tool to steer people in a preferred direction by manipulating their nonconscious behaviour. They employed the environment as a so-called *choice architecture* that can be designed in such a way that it stimulates certain behaviour. They coined the term nudging to describe the inherent steering capability that any environment possesses. They argue that the environment affects the behaviour people perform, and that behaviour can be influenced by altering the environment in which an individual makes nonconscious behavioural choices, introducing the subject of nudging in the social-spatial research domain. This choice context can be constructed by a choice architect, who designs the way in which options are presented. Therefore, the choice architect can alter the social and physical environment to make it much more likely that a particular behaviour becomes the natural or default preference. This technique is named nudging, indicating a subtle 'push' in the right direction without restricting the freedom to choose other options. To count as a nudge, the intervention must be cheap and easy to avoid, as nudges are not mandates. Thaler and Sunstein apply their theory to societal problems like obesity and other lifestyle problems, traffic safety, sustainability and more (Thaler and Sunstein, 2008).

01.1.2 EMBEDDING IN POLICY

Nudging gained traction in science as well as politics since it provides potential for a whole new set of behaviour change interventions. Scientists as well as policy-makers are becoming more attentive to the potential of nudging. This development coheres with ongoing societal trends towards liberalisation and deregulation. Citizens are expected to make informed and well-considered choices independently in numerous fields. Governments can apply nudging in order to regulate nonconscious behaviour in public space, since they aim to promote and stimulate specific behaviour in this particular domain. Through nudging, designers and architects materialise these thought processes in the physical landscape. Citizens respond to them, and thus they become more likely to perform the

desired behaviour. However, nudging techniques are not restrictive, and other options are always left open.

The Dutch government is currently confronted with issues caused by the summation of multiple individual behaviours, for example in the beforementioned fields of health, safety, and sustainability. Many of the goals to which the government aspires can only be achieved when individuals change their behaviour. Consequently, understanding how to change behaviour is a concern for any government policy (House of Lords Science and Technology Select Committee, 2011). Citizens' freedom of choice and responsibility is emphasised, but this should be facilitated by fitting policy. This is congruent with the principles of nudging. Knowledge about this topic can aid the government into creating policy which connects the wants and needs of the government to the perception and implementation from a user's point of view (Tiemeijer et al., 2009; WRR, 2014). Therefore, more understanding is necessary to assure the well-being of citizens.

Dutch planning and design policy is concerned with the influence of the environment on human behaviour. Multiple policy documents stress the issue. The *Wetenschappelijke Raad voor Regeringsbeleid* (WRR) [Scientific Council for Government Policy] have recently put forth an investigation about the importance of psychology of choice and behaviour (Tiemeijer et al., 2009), and subsequently published a document on the creation of new policy based on this knowledge (WRR, 2014). In both documents, the concept of nudging is briefly elaborated upon, and its importance in a planning and policy context is emphasised. The *Raad voor Maatschappelijke Ontwikkeling* (RMO) [Council for Societal Development] also discuss the influencing of behaviour through nudging by the government, but focuses more on the ethical aspects of the topic (RMO, 2014). Even though these documents emphasise the importance of nudging as a new policy tool, more detailed information about its implementation is often lacking.

01.1.3 DELINEATION OF EXISTING LITERATURE

There is increasing attention for nonconscious behavioural processes in the environmental behaviour research domain. This is caused by a conversion in the field towards a realisation that citizens' behaviour in public space can be influenced by the environment, and that rational strategies are not sufficient in order to alter behaviour. They need to be complemented by strategies that address the nonconscious, automatic behaviour system. Therefore, opportunities for new instruments lie in the concept of nudging. An interplay between physical and social strategies can induce desired behaviour to occur. This leads to a paradigm shift from environmental determinism to environmental probabilism. Whereas environmental determinism believes that the environment has a determining influence on human behaviour, environmental probabilism believes that in a given physical setting

some choices are more likely than others (Carmona et al., 2003; Gifford, 2007). This paradigm conversion is reflected in scientific research.

In the past forty years, a number of authors have already studied the influence of the physical environment on human behaviour in different ways. The development of concepts and theories in this field coheres with the previously described shift from environmental determinism to environmental probablism. Early theories are founded in the social engineering practice that became predominant after WWII. They view the relationship between humans and the environment as a relationship that is merely defined by physical restraints. Later, there is a gradual shift towards the idea that this relationship is defined by the perception of possibilities, and culminates in the idea that even nonconscious perception of the environment can evoke specific behaviour.

J. J. Gibson introduced the concept of affordances, indicating the relation between an object or an environment and an organism, that affords the opportunity for that organism to perform an action. Gibson defined affordances as all action possibilities latent in the environment, objectively measureable and independent of the individual's ability to recognise them, but always in relation to agents and therefore dependent on their capabilities (Gibson, 1977; Gibson, 1979). Norman adapted the concept of affordances to be relational rather than intrinsic, which he deemed a more ecological approach. In this sense, affordances are all actions that the individual perceives to be possible to act upon (Norman, 1988). The theory of affordances caused developments in the field, as it introduced a new perspective upon the relationship between humans and their environment. Previous research has assumed that actions are either possible or impossible, and the individual user has a perfect perception of these possibilities. However, Norman suggested that the perception of users is flawed, and in fact affordances are the possibilities that they *perceive* to be possible in a certain environment. Therefore, the role of the individual user changes from an object to a subject in the environment. Subsequent authors developed this idea. In order to delineate the current study field, three theories will be discussed in the following paragraphs, namely priming, environmental cues and nudging.

Bargh et al.'s studies were instrumental in defining the perspective that behaviour is often driven by nonconscious determinants. Through priming research, they demonstrated that activating a construct in the mind is sufficient to elicit behavioural effects (Bargh et al., 1996), the so- called automotive model of nonconscious goal pursuit (Bargh et al., 1990). The auto-motive model argues that goals can be nonconsciously activated by features of the context or environment in which they are pursued (Bargh et al., 1990; Oettingen et al., 2006). Their research was performed through priming, i.e. making people nonconsciously look at words or objects relating to specific behaviour like

politeness, competitiveness, or happiness, and testing if they performed according behaviour afterwards. More researches were performed to provide empirical evidence towards the relationship between the activation of mental concepts and resulting behaviour. It became clear that behaviour can become activated automatically when we enter a specific environment or encounter a specific situation. Thus, the goals associated with that environment become activated and begin operation, even if the individual is not consciously aware of this (Bargh et al., 2001; Gross, 2007). These researches left little room for the belief that all behaviour must be preceded by nonconscious thought (Gollwitzer and Bargh, 1996). Bargh et al. touched upon the importance of the physical environment in activating behaviour and studied it in some cases, however, their research was focused more on semantic priming rather than object or environmental priming.

Lindenberg combined the subjects of nonconscious and automated behaviour with behaviour in public space, arguing that environmental cues can strengthen or weaken normative goals, goals related to "acting appropriately". When such a goal is activated, it will influence what people think, what information they are sensitive to, what action alternatives they perceive, and consequently how they will act (Lindenberg and Steg, 2007). Bargh argued previously that through the automotive model, norm activation can happen nonconsciously due to the influence of the environment. Lindenberg argues that environments are never neutral, and each environment sends out cues that influence behaviour. Lindenberg argues that insight into the power of environmental cues provides potentially new and powerful tools for interventions in favour of normative behaviour (Lindenberg, 2013).

Nudging was coined in 2008 by Thaler and Sunstein and is therefore one of the most recent developments in the field of nonconscious behaviour change. The book *Nudge: Improving Decisions about Health, Wealth, and Happiness* explains that most human behaviour is performed nonconsciously. Therefore, instruments aiming to achieve behaviour change should play into this knowledge. As people don't necessarily always make rational judgements and decisions, nudging can assist them in making these nonconscious decisions through the design of the physical environment (Thaler and Sunstein, 2008). This environment can serve as a cue for specific behaviour that is desired in that particular context. Therefore, the design of this environment is a key factor in the resulting behaviour of its users. This should be taken into account when designing any new environment. In this thesis, it will be investigated how nudging can provide a whole new array of instruments for spatial planners and landscape designers.

On the other hand these is a broad range of existing instruments employed in spatial planning and design at the moment. They have been extensively tested and used in practice and therefore they

are important to mention. These instruments may be complemented by new techniques founded in nudging. The current instruments are generally reflective in nature. At present, three main strategies can be distinguished, namely legislative, financial, and discursive instruments. Strategies that are currently already widespread have been extensively discussed in professional literature (see e.g. De Roo and Voogd, 2004; Hidding, 2006; Fenger and Klok, 2008; Van Schijndel et al., 2011), and this knowledge sometimes touches upon behavioural change through design interventions. Fenger and Klok elaborate upon the functions and applications of the different instruments belonging to the three main strategies of legislative, financial, and discursive. Also, they discuss the relationship between the different instruments and resulting behaviour (Fenger and Klok, 2008). However, few other articles stress the presence of physical interventions and their effect on behaviour. An improved understanding of the concept of nudging and its application can aid the investigation into different behaviour change methods in the physical environment. In this way, a new strategy can be explored, and a whole new set of behaviour change instruments can be employed.

01.3 SCIENTIFIC OBJECTIVES

The objective of this thesis is to explore the workings and applications of nudging techniques by researching existing literature in the field of decision-making, affordances, priming and environmental cues, in order to investigate how behaviour is affected by environmental attributes. Therefore, it is important to understand how the design of the physical environment influences nonconscious and automatic behaviour. In particular, this thesis is driven by the challenge to deepen theoretical knowledge by establishing a link between nudging and established theory, and to develop an understanding of potential interventions aimed at achieving behaviour change. The beforementioned theories are used to understand automatic behaviour change through interventions in the physical environment, solving issues of definitional and conceptual clarity. These are thereafter employed to develop a better understanding of nudging, that can be applied to understand practical societal issues. By creating a comprehensive theoretical overview that explains the effects of design interventions, more applied research can be performed. Finally, the concept is tentatively tested in a field experiment to demonstrate the use of the concept of nudging, in order to discern its feasibility and recognise its practical value.

To achieve this objective, the thesis has a multiplex aim. Firstly, the thesis aims to research, compare and contrast currently existing literature within the field of automatic behaviour change through understanding human-environment relationships. Secondly, the thesis aims to deepen this

knowledge by synthesising this theory into an encompassing framework resulting in a comprehensive theoretical overview that can explain the workings of human-environment relationships with regard to the change of automatic behaviour through nudging, based on arguments founded in the literature study. Thirdly, the thesis will test the concept of nudging in an empirical manner, by applying the results of the literature study to an existing environment. However, research on nudging presents an epistemological problem. Decision-making is a process that exist only in the minds of people, and the resulting behaviour is often nonconsciously executed. Therefore, I will study something I can measure, namely the consequences of these actions.

The research will add insight into the relationship between humans and the physical environment. It investigates if and how the design of the everyday environment can nudge automatic, nonconscious effects on behavioural choices. This contributes to the theoretical reconstruction of the application of nudging through physical interventions as a tool in planning and design practices. This objective will on the one hand deepen the theoretical scientific knowledge on this topic, and on the other hand it has the potential to contribute towards solving practical societal issues that can benefit from this.

Thus, this thesis has three main aims:

- Research, compare and contrast currently existing literature on decision-making, affordances, priming and environmental cues
- Employ the literature to explain the concept of nudging
- Test the working of nudging in public space

The goals of the presented research are both exploratory and explanatory in nature. The exploratory character of the research stems from the objective to satisfy curiosity and provide better understanding of the automatic behaviour process. The thesis provides illumination upon this process. The explanatory character of the research is founded in its aim to suggest reasons for these events, by questioning theories and substantiating them through empirical research.

Relating to its exploratory nature, this thesis is theoretically relevant because of its contributions in the field of automatic behaviour change and behavioural change instruments. The fundamental nature of a sound literature review is taken as the basis for theoretical advancement. By investigating, correlating, and comparing and contrasting existing theories, a synthesis can be achieved in which an encompassing framework for understanding automatic behaviour change is developed. This deeper understanding of the effect of the environment on behaviour can improve the fields of spatial planning and design. Moreover, it can offer insight into new relationships between existing concepts in order to bridge the gap between the social and the spatial sciences.

Furthermore, this thesis can provide empirical evidence towards these theories, improving their overall trustworthiness. Thus, an explanatory approach can substantiate the theoretical claims that are made. Since this kind of research has not been performed previously, the empirical research contributes to the validation of the presented theories.

02. LITERATURE REVIEW

As mentioned, the concept of nudging has been coined in the book *Nudge* by Thaler and Sunstein (2008). However, little attention has been paid to the theoretical underpinning of this concept, and how it can be applied in practice. Therefore, in the literature review, other theories that support the claims made by Thaler and Susntein are elaborated upon. The goal of the literature review is therefore to establish the concept of nudging within the field of environmental behaviour.

First, nudging theory will be explained in more detail. Thereafter, four theories have been chosen to set forth the argument that the concept of nudging can be employed as a spatial instrument to steer behaviour in public space. The affordance theory by J.J. Gibson was the first to propose an ecological take on the human-environment relationship. This theory elaborates upon the perceived opportunities for behaviour that are assumed to be present in each environment, or what the environment *affords* the individual. Thereafter, theories about decision-making are set forth to describe how individuals make choices between these different opportunities that are present. Subsequently, priming theory is elaborated upon, to illustrate how the concept of nudging could work and provide examples from other fields. Then, the theory of environmental cues is described, in order to understand how physical elements in the environmental can influence behaviour. This might give an indication of how nudging can be applied. Finally, the different theories are linked to the concept of nudging, and it is explored in which ways nudging might be implemented in public space.

Each theory commences with a theoretical analysis of the concepts and the research that has already been done. Thereafter, its application in practice is described, and the current debate is discussed, in order to place the theory in the present context. The purpose of each of the theories in relation to the concept of nudging is described. These paragraphs will place the topic in a historical perspective, identifying key studies and selecting key sources and authors. Furthermore, it will establish the context for the interest of this thesis, and distinguish what has been done in order to identify space for further development.

Thus, the literature review provides the foundation for answering the first and second research questions as presented previously, namely “How do humans make decisions about behaviour?” and “Does the literature on nonconscious decision-making support the premise of the concept of nudging?”. It analyses existing literature and synthesises this information as a basis for understanding nudging.

02.1 NUDGING AND CHOICE ARCHITECTURE

The theory on nudging and choice architecture highlights the potential for spatial interventions to alter behaviour. The theory by Thaler and Sunstein is set forth, and complemented by work on the concept of nudging by several other authors.

02.2.1 THEORETICAL ANALYSIS

Nudge by Thaler and Sunstein advocates non-regulatory interventions that influence behaviour in ways that people often do not notice. They define these interventions as nudges. Nudging is a subset of non-regulatory interventions that prompt choices without getting people to consider their options consciously (House of Lords Science and Technology Select Committee, 2011). According to Thaler and Sunstein, a nudge is "any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be cheap and easy to avoid. Nudges are not mandates" (Thaler and Sunstein, 2008). This approach differs from more traditional attempts to change behaviour, which have used either regulatory interventions or relied on overt persuasion. Oftentimes, nudges are favoured over regulations or prohibitions. *Nudge* defends three main claims, namely (1) the choice architecture notably influences how people make choices, (2) choice architecture is unavoidable, and (3) it is possible to nudge whilst preserving freedom of choice (Leonard, 2008).

The ideas presented in *Nudge* are greatly based upon the behavioural economist view that sometimes individuals are not the best judges of their own well-being. People often rely on automatic thinking when they have to make fast decisions. Biases or flaws in the mind can undermine these decisions, causing the results from automatic decision-making to be incongruent with deliberative decision-making. The context of decision-making may systematically lead individuals to fail in acting on their rational intentions. Nudges can remind people of what they rationally know, but don't act upon, through the material shaping of objects and the environment (WODC, 2014). Through nudging, interventions can anticipate nonconscious mental processes that entice people to perform behaviour which is desirable from society's point of view. Therefore, nudging can steer decisions of people who are not influenced by the classical set of instruments (Scherpenisse et al., 2014). Choice architects can therefore arrange the decision-making context in ways that promote behaviour that serves our own, as well as society's, general interests. Manipulation through nudges can be used as effective means for choice architects to aggregate these choices, without restricting freedom of choice or imposing traditional coercive planning instruments (Hansen and Jespersen, 2013; Selinger and Whyte, 2011). Due to their propensity for

making cognitive errors, humans make predictive, systematic and recurring mistakes in complex decisions. Nudging is a deliberate effort to guide people into making the choices that are best for them, lessening the negative impacts of automatic thinking. However, nudges are non-coercive, and therefore there is always a way to opt out of the promoted decision (Schlag, 2010). Scientific knowledge of these tendencies to make irrational decisions can be applied to design projects that nudge people to make better decisions, whether or not they are aware of it. Nudges are changes in the decision-making context that prompt us below the level of our awareness to make better decisions, thus modifying behaviour. In these circumstances, nudges influence the automatic aspect of an individual's choices or actions (Selinger and Whyte, 2011).

Thaler and Sunstein refer to this decision-making context as the choice context, designed by the choice architect. The choice architect has the responsibility for organising the context in which people make decisions (Thaler and Sunstein, 2008). Choice architecture therefore refers to the environment in which an individual makes choices. The way in which a choice is presented influences the choice a decision-maker chooses, and therefore by changing the way in which options are presented through altering the physical environment, particular choices can become much more likely (House of Lords Science and Technology Select Committee, 2011). The environment of people plays a large role, because people interpret the feedback they receive from their environment to ascertain more confidence about their behaviour (Scherpenisse et al., 2014). Choice architects can make major improvements to the life of others by designing user-friendly environments. Accordingly, the principles of good architecture should always be to make the life of users as easy as possible (Thaler and Sunstein, 2008).

Nudge incorporates an appeal to the political spectrum as well. Institutions inevitably structure the choices that people make, and therefore they should be careful about how to structure the choice context. The choice architect should frame the choices so as to lead most humans to make choices that are right for them (Schlag, 2010). They delineate this perspective as libertarian paternalism. On the one hand, nudging promotes libertarian decision-making because individuals are still free to do what they like, and to opt out of arrangements that they consider to be undesirable. On the other hand, nudging can be seen as a form of paternalism, since it is legitimate for choice architects to make efforts to influence people's behaviour in order to improve their lives (Thaler and Sunstein, 2008). Yet, where paternalism is coercive, libertarian paternalism aids people without compulsion. By steering the subject, the option to choose another course is always left open (Leonard, 2008). In this manner, Thaler and Sunstein place two ideological competitors into the same theory (Schlag, 2010).

Thaler and Sunstein offer the basic principles of effective choice architecture as an acronym of "nudges", namely i**n**centives, **u**nderstanding mappings, **d**efaults, **g**ive feedback, **e**xpect error, and **s**tructure complex choices. Incentives are associated with questions of who pays and who profits from the nudge. The relationship between a choice and resulting welfare is defined as a mapping. To understand mappings creates a good system of choice architecture, that helps people improve their ability to map and hence to select options that will make them better off. One way to achieve this is to make information more comprehensible. Default selections can be deployed to stimulate people to take the option that offers the least resistance. Most people can be expected to end up with the default option, but not all defaults are selected to make the individual's life better or easier. Required choices can be inserted to force people to make a decision, but these are best suitable for simple decisions and not for complex choices. Give feedback merely indicates that a choice architecture should alert people when they are doing well or make mistakes, warning them if things go wrong. Furthermore, the choice context should be made fool proof by expecting error from users and anticipating upon these errors. Finally, simplifying strategies can be employed to structure complex decisions (Thaler et al., 2012).

Thus, there are three main characteristics of nudging. The first is that nudging has a generic pretext, meaning that the nudge is aimed at the entire population, and not on individual problem cases. Secondly, there is a psychological component. It assumes that people make decisions based on habits, and nudges can stimulate these decisions towards specific behaviour if they are encountered at the right time. Finally, nudging is based upon a positive behavioural norms. It defines a preferable behaviour, which it aims to promote (Peeters and Schuilenburg, 2014). As demonstrated, Thaler and Sunstein provide various tools and principles aimed at implementing nudges. Johnson et al. divide these tools into two categories, tools structuring the choice task and tools used in describing choice options. Tools for structuring the choice task address the idea of what to present to decision-makers, whilst tools used in describing the choice options address the idea of how to present it. They argue that there are many ways to present a choice to the decision-maker, and what is chosen often depends on how the different options are presented. These tools address mental problems that can be solved through nudging. In setting up the task, the main problems are alternative overload, decision inertia, and procrastination. They can be addressed through interventions that reduce the number of alternatives, or technological aids that support the decision procedure. A solution that addresses decision inertia is the careful consideration of defaults. Changing the default behaviour to the preferred behaviour can be influenced through nudging. Deviating from the preferred behaviour is still possible, but it is made much harder. For example, the stairs can be placed in a location which is visible and accessible, whilst the elevators or escalators are located more towards the back.

Procrastination can be solved by imposing limited time windows, that stimulate people to perform a certain action. For example, residents of a large city postpone visiting landmarks, whereas tourists who reside in the city for a limited amount of time do visit these because of the limited time they have. In describing the options, the problems are naïve allocation, attribute overload, and non-linear attributes. In order to solve naïve allocation, options can be partitioned into different sections or under different headings to affect the choices that are made. Attribute overload can be addressed through attribute labelling or the provision of structured information. Non-linear attributes can be solved through rescaling. Finally, Johnson et al. provide tools that cover implementation issues in choice architecture. They define two problems, namely the existence of differences between individuals, and outcome valuation of users. Individual differences can be dealt with by providing customised information. In traffic studies, for example, green waves are interventions that provide feedback to passing cars about the speed with which they are able to cross many green traffic lights without stopping. To solve outcome valuation, it is also important to focus on the experience which is offered by a nudge. Nudges should not only be effective, but also enjoyable (Johnson et al., 2012).

02.2.2 Application

Thaler and Sunstein describe a great deal of applications of the nudging and choice architecture theory in their initial book on the topic. They mainly focus upon applications in healthcare, lifestyle and obesity, retirement and health insurance choices, traffic safety, security, and sustainability and environmental conservation. They describe piecemeal applications of their theory, but applied scientific testing has not been found. Still, the theory has been adopted by many governmental institutes and policy-makers, both in North-America and in Europe (including e.g. England, The Netherlands, and Sweden). These describe how choice architecture can function as a non-coercive intervention method, and they report many successful applications. Nudging and choice architecture research currently comprises many potential applications and issues. However, not all themes are specifically spatial in their nature. For example, a large part of the literature is focused on insurance policies, marketing and sales, and default settings for choices such as smartphone settings or organ donation. However, there is also a part of the literature that focuses on themes that require spatial interventions and result in spatial behaviour, rather than only mental choices. These themes focus on the topics of diet and lifestyle, safety and security, and sustainability and environmental conservation. However, scientific evidence is still insufficient, and there is little understanding of a coherent framework of interventions, or the processes that lie behind the implementation of nudging.

Nudges can be applied through two different procedures, both relating to the dichotomy of the mental system described previously. They are therefore indicated as type 1 nudges and type 2 nudges. Type 1 nudges are based in the automatic system, and therefore they lead to behaviour without engaging reflective thinking. Examples are the presence of road side-lines to draw the illusion of a narrower road and a faster speed, in order to get drivers to slow down near dangerous curves. Another example is the shrinking of plate sizes, and using colour, music, and light, in order to decrease portion sizes in self-service restaurants. Individuals are unaware of the result of these interventions, but they still affect behaviour. On the other hand there are type 2 nudges, which are specifically aimed at attracting reflective attention during processes that normally only involve the automatic system. Examples are the fly-in-the-urinal that help to improve aim and keep the bathroom environment clean, stickers that remind users to turn off the light in a room, footprints on the street that lead towards trash cans, or 'piano stairs' that make a sound when someone is using them. All of these interventions require active attention from the user, who is then more likely to perform the normative behaviour (Hansen and Jespersen, 2013).

Hollands et al. propose a typology of nudging interventions in health sciences because, they argue, there has been a lack of conceptual clarity and agreed-upon terminology so far. A subdivision is made between interventions that address the properties of objects and the environment, and interventions that address the placement of objects within the environment. Their provisional typology comprises seven intervention categories, namely ambience, functional design, labelling, presentation, sizing, availability, proximity, priming, and prompting. There is a potential to apply these interventions, which have been focused on one behavioural domain, and develop and test them in other domains (Hollands et al., 2013).

Since nudging is a relatively new concept, not all researchers are clear on the operational definitions and terminology to be used. Still, examples of nudging can be found, especially through applying snowball searches. Nudging is a varied palette of instruments, but it has not been defined clearly yet. It is therefore important to analyse all the instruments that are applied. Nudging is very context-related, and it is important to differentiate in nudging. Not all interventions can be similar, and every nudge has to be fitted within its specific environment. The application of findings from behavioural psychology has to be combined with shaping theory and testing hypotheses (Scherpenisse et al., 2014). Many researches only name a few examples of nudging without studying their effects in particular. In appendix A, a table is provided that lists all the examples of nudges encountered during the thesis.

02.2.3 DISCUSSION

Many discussions surround the concepts described in *Nudge*, which are mainly of ethical nature. Moreover, Thaler and Sunstein endeavour to appeal to a wider audience, but this results in a popular science book that is written in non-technical language and aimed at the general reader. This affects the level of depth in the argument, but it does blend storytelling and technical writing to combine into an innovative and appealing whole. Hence, Leonard (2008) argues that even though *Nudge* is "costumed in the guise of pop economics, it is in fact a manifesto for a new paternalism that is well written, witty, and loaded with crisp summaries of the psychology literature on human fallibility". However, due to the popularity of the nudge concept, it is approached by many users who are not completely familiar with its meaning. Mistaken nudges occur when nudging initiatives are in fact prohibiting or offering financial incentives in order to achieve a goal, contrary to the definition of nudging (Selinger and Whyte, 2011).

Advocates of the *Nudge* principles claim that it is in fact impossible to avoid choice architecture. The choice context always has to be designed in some way, and therefore it is important to consider the implications of design (Selinger and Whyte, 2011). Thaler and Sunstein obviously agree with this perspective, and argue that it is impossible not to influence people's choices, and in all situations some agent must make a choice that will affect the behaviour of people. There is thus no way of avoiding nudging in some direction. Even though it is true that some nudges are unintentional, and antinudge position is a nonstarter for it cannot exist. Still, institutions can strive for neutrality in the nudge considerations (Thaler and Sunstein, 2008). The choice architect needs to balance two criteria, namely the number of options that are provided, and which cannot easily be restricted due to the freedom of choice that choice architecture is founded upon, and the cognitive burden which is presented by these options (Johnson et al., 2012).

Behaviour can be influenced by altering the environments within which people make choices. However, empirical evidence to support this idea is limited. Limitations are not due to absence of evidence, but also due to a prior lack of definitional and conceptual clarity. Thaler and Sunstein offer no operational definitions of what choice architecture and nudging mean in an applied sense. Definitions are largely implicit in the illustrative examples, and apply to specific behavioural and environmental contexts. The fact that terminology continues to be used inconsistently emphasises the need for a more systematic approach to conceptual development (Hollands et al., 2013). Moreover, choice architects will have to design decision environments faced by decision-makers in light of knowledge about the decision environment, but also with knowledge about the characteristics of targeted decision-makers and how they will process and draw meaning from

information, or what their goals are (Johnson et al., 2012). Nudging theory needs to be linked more strongly to validated understandings of the cognitive process that it relies upon.

02.2 AFFORDANCES

The theory of affordances provides a general introduction into the idea that the environment can afford opportunities for action for individuals. This theory serves as the foundation of understanding for human-environment relationships in this thesis, as it demarcates how different opportunities for behaviour exist in the environment.

02.2.1 THEORETICAL ANALYSIS

Different authors have studied the influence of the physical environment on human behaviour. Key contributor J. J. Gibson introduced the concept of affordances, indicating the relation between an object or an environment and an organism, that affords the opportunity for that organism to perform an action. Gibson defined affordances as all action possibilities latent in the environment, objectively measureable and independent of the individual's ability to recognise them, but always in relation to agents and therefore dependent on their capabilities (Gibson, 1977; Gibson, 1979). From affordance perspective, behaviour can be defined as what happens at the conjunction of complementary affordances and intentions or goals. The theory of affordances caused developments in the field, as it introduced a new perspective upon the relationship between humans and their environment. There remains considerable uncertainty about what is exactly meant by an affordance, which can complicate attempts to apply the concept to study and understand behaviour or to design human-environment systems that optimise behaviour (Stoffregen, 2003). This issue has given rise to considerable debate on the formal definition and application of the concept. The original definition of Gibson will be elaborated upon, and thereafter the perspectives of various other authors are illustrated.

"The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" (Gibson, 1977)[1]. This definition implies the complementarity of the individual and the environment. Affordances are properties that do not inhere in either the environment or the individual, but rather emerge from the human-environment system as a whole. Affordances are

[1] A note on the adopted terminology. Gibson consequently uses the word "animal" to refer to the organism that is the subject of his discussions. Other authors have mixed preferences for using the words "animal", "organism" or "individual". Since this thesis will only discuss affordances in a human-environmental context, the word "individual" will be adopted throughout.

relations between an individual and its environment that have consequences for behaviour (Stoffregen, 2003). Chemero attempts to create a marginally more specific definition, and argues that affordances are relations between particular aspects of individuals and particular aspects of environments. Hence, the environment affords a certain behaviour to the individual. The relation is not inherent in the environment or in the organism, but rather in their combination (Chemero, 2003). Affordances are not just abstract physical properties, but they have unity relative to the posture and behaviour of the individual being considered. An affordance is measured relative to the individual, and it is therefore unique to that individual. Different objects in the environment have different affordances for usage or manipulation. Furthermore, other individuals can afford a complex set of interactions and behaviour, comprising a whole realm of social significance of affordances for human beings (Gibson, 1979). The affordances theory gives rise to an ecological psychology approach. This indicates that affordance is a resource that the environment offers any individual that has the capabilities to perceive and use it. Affordances are meaningful to individuals, as they provide opportunities for particular kinds of behaviour. Thus, affordances are properties of the environment taken relative to an individual (Chemero, 2003). It follows that there are three perspectives from which affordances can be viewed. The individual agent perspective indicates which affordances are perceived by the individual. The observer perspective indicates which affordances are present in a specific human-environment system. Finally, the environment perspective indicates which affordances are offered by the physical environment. Gibson himself argues that architects and designers already know many facts about affordances. For example, they are aware that glass affords seeing through but not going through, and curtains, on the contrary, afford going through but not seeing through. However, they lacked a theory of affordances to encompass this knowledge into a system (Gibson, 1979).

Distinctions can be made between different concepts within the affordances theory. Firstly, there is a division between inferential and direct theories of perception. Inferential theories of perception state that the location of perceptual content is in the mind, and therefore meaning arises inside individuals. On the other hand, direct theories of perception state that meaning is actually in the environment, and the individual simply gathers its information and acts upon this (Chemero, 2003). A dispositional property is a thing that is a potential or latent or possibility for action. An affordance is the disposition of a particular surface layout or object in the environment. An effectivity is the complementing disposition of a particular individual. Therefore, an effectivity is the causal propensity for an individual to effect or bring about a particular action. Affordances are dispositional properties of the environment, whereas effectivities are dispositional properties of the individual. When these two meet in space and time they can get actualised (Turvey, 1992). Also, Gibson distinguishes

between attached objects and detached objects. Attached objects are the fixed features of the environment around us, like surface and texture. Detached objects are mobile elements within this environment. They must be comparable in size to individuals if they are to afford behaviour. Those objects that are comparable can afford a great variety of behaviours, both intentional and unintentional. Both attached and detached objects can be manufactured and manipulated, but only detached objects are portable or graspable. Such objects can also be defined as tools, and they all have their unique properties and qualities (Gibson, 1979). Since humans are not usually aware of perceiving affordances, the perception is automatic. The environment is acted upon without a reflective process at the basis of behaviour, but rather an automatic one (Chemero, 2003). Orthodox psychology asserts that we perceive these objects by their properties or qualities. However, Gibson suggests that what we perceive when we look at objects are their affordances, and not their qualities. Individuals are able to discriminate the dimensions of difference between objects when asked to, but what the object affords us is what we usually pay attention to. This again relates to the automatic nature of perceiving affordances. Perception is an economical process, and it is easier to perceive an invariant unit than it is to perceive all the variables separately. It is never necessary to distinguish all the features of an object to be able to use it, and it would be impossible to do so. Furthermore, according to Gibson in his original works, affordances cut across the objective-subjective dichotomy as they are simultaneously comprised of real and physical environments, but on the other hand also include mental meanings. They are equally facts of the environment and facts of behaviour, as affordances are used to indicate the relationship between the two and therefore points both ways, towards the environment and towards the individual agent (Gibson, 1979).

Affordances can also be misperceived. Gaver (1991) divides these affordances into two categories, namely hidden affordances and false affordances. Hidden affordances indicate a possibility for action, but this affordance cannot be perceived directly by the individual. False affordances seem to offer potential for action, but these possibilities are actually non-existent. Moreover, affordances can be negative. Objects can also cause displeasure or even injury. It is important to keep this in mind in designing (Gibson, 1979).

Finally, the richest and most elaborate affordances of the environment are provided by other individuals. They can be seen as unique objects within the environment, as they are detached objects that make spontaneous animate moments. They can interact with the observer, but also with each other. Gibson (1979) argues that behaviour affords behaviour, and every behaviour depends on the perception of what other individuals afford in a specific environment.

02.2.2 APPLICATION

Affordances are the qualities of an object or environment that afford an individual to perform a specific behaviour or series of behaviours. The theory of affordances can be applied by relating the analysis of the physical environments of individuals, understanding environmental affordances, and the consequent behaviour (Milgram and Jodelet, 1970). The theory has been applied to a great deal of cases, but most deal with human-object relationships. In this paragraph, the focus is on instances where affordances have been applied to human-environment relationships. There are two main research fields within this subject. One focuses on children's affordances, and the second focuses on the application of the concept of affordances to sustainability.

Many studies investigate the importance of affordances of children's environments. They study the functional significance of environments for play, learning, and interaction. Children's outdoor activities can be described in terms of affordances rather than forms, explaining how children perceive different elements in the environment. For children, it is not the form of the environment that matters, but its functional significance, that determines what behaviour the environment affords. These affordances have been derived from a focus group discussion examining the use of home and school environments. In the main study, participants rate how many places there are in their environment for each of the affordances and also to rate how often they used that environment for that affordance, using a three-point Likert scale. Participants also ranked the environments in order of preference (Clark and Uzzell, 2002). Affordances have the potential to invite behaviour, but the agency of children regulates which possibilities are actualised. Prieske and Withagen (2015) investigate if children are more attracted to environments that provide challenging affordances. They examined thirty children playing freely in a playscape consisting of blocks that varied in height and distance from each other. The perceived and actual boundaries of children were measured through their ability to cross gaps of certain widths. Kyttä (2002) concludes that rural environments can encourage children to create their own affordances, and therefore designed affordances are not prerequisites for play. This has been studied by means of interviews with children living across different environmental settings.

Other studies focus on the importance of affordances for sustainability. Seyranian et al. (2015) study how understanding the important and meaning of different affordances of water can assist in implementing water conservation interventions. They measure short-term and long-term water consumption after participants received one of four possible water reduction interventions. Duffy (2009) examines whether the perceptual affordances of specialised waste container lids improve recycling compliance. This is achieved through counting the number of recyclable items found in

waste bins of different designs. In both studies, results are positive, indicating that an understanding of affordances allows for an improved implementation of sustainability interventions.

02.2.3 DISCUSSION

Ever since Gibson coined the concept of affordances, debates upon this subject have been widespread. The most important discussions will be highlighted. There is considerate debate about the exact definition of the concept of affordances. These discussions are mainly focused upon (a) what kind of properties of the environment affordances are, and (b) what it is about individuals that affordances are relative to (Chemero, 2003). Two main viewpoints exist in the first debate. Reed argues that affordances are resources. He calls the resources encountered by an individual the affordances of its environment. Affordances are not causes or stimuli, but opportunities for action. They can be used and they can motivate an individual to act, but they do not and cannot cause the behaviour that utilises them (Reed. 1996). Steedman completely skips the perceptual aspect of affordances, and claims that an object is linked with specific actions, relating affordances to the object-schema theories discussed previously (Steedman, 2002). However, actions require that the behavioural possibilities of surface layouts and objects in the environment are perceived (Turvey, 1992). Gibson himself also sets forth an ecological definition of the concept of affordances. He states that the concept of affordance is always present in an object, no matter how the need or attention of the observer changes. The object offers what it does because it is what it is, and thus it possesses meaning and value. These affordances are specified in stimulus information towards the individual agent (Gibson, 1979). On the other hand, Stoffregen takes a more selectionist view, arguing that affordances are resources that a particular individual can perceive. He believes that defining affordances as properties of the environment cannot work, it is incompatible with characteristics of opportunities for action (Stoffregen, 2003). Norman also argues that affordances are not all action possibilities that are latent in the environment, but only those action possibilities that are perceived as such by their users (Norman, 1988). Gibson agrees, stating that adapting his original definition later to describe only those action possibilities of which an actor is aware. Furthermore, he argues that to perceive an affordance is not equal to the classification of an object. The fact that an object has a certain affordance does not imply that it cannot be other things as well, depending on the perception and interpretation of the user. All these affordances are consistent with one another, since they exist within the same object, but by applying different behaviours one object can be used to pursue a variety of goals (Gibson, 1979). The second debate on the definition of affordances revolves around the question which components of individuals affordances are relative to. Turvey argues that affordances must be complemented by properties of individuals. He presents yet another formal definition of affordance, namely: “an affordance is an invariant combination of properties of

substance and surface taken with reference to an [individual]". From his perspective, affordances for actions are fundamental and perceived directly. Turvey takes a materialist view towards affordances, arguing that nothing exists but matter, and therefore perceiving and acting are completely attributable to material agency. Possibilities for action are real states of affairs, that exist independently of perceiving or conception (Turvey, 1992). Warren performed an important research on stair-climbing affordances, indicating that affordances are body-related, the bodily scale and affordance need to match in order for the relationship to work. From this perspective, affordances are defined as functional utility of an object for an individual with certain action capabilities (Warren, 1984). This demonstration of the theoretical field revolving around the concept of affordances suggests that many authors agree that affordances are human-relative properties of the environment. There is some disagreement whether or not these properties still exist without the presence of individuals. Therefore, the discussion focuses on debates inquiring whether affordances are resources of the environment or dispositional properties that must be complemented by some property in individuals. Finally, there is also a disagreement over what exactly these properties in individuals are, individual abilities or body scale.

02.3 DECISION-MAKING

To understand how individuals make choices between different behaviour options, it is crucial to understand how decisions on behaviour in the environment are made. In these paragraphs, the mental process behind automatic behaviour is explored. These theories are presented because they provide a proven and widespread accepted model to understand why the consecutive theories about human-environment interaction and automatic behaviour change work. The theory is organised from a broad description of the dual cognitive system in the mind, towards a specific explanation of how environmental schema work to activate behaviour, in order to demonstrate the mental process and its relation to the environment. In short, the dual cognitive model recognises that there are two processes happening in the mind, namely the nonconscious, automatic system and the conscious, deliberative system. Focusing on the automatic system, norms can be activated through the design of the physical environment. This triggers the activation of an appropriate schema or script, which guides action in a specific environmental setting. This can be applied in this thesis to explain why specific behaviour is performed in specific environments and influenced by physical objects. These theories are elaborated upon below.

02.3.1 COGNITIVE SYSTEMS

Cognitions are mental dispositions that are used in perceiving, remembering, thinking, and understanding the world around us. Perception is the process by which an individual receives, selects, organises, and interprets information in order to create a meaningful picture of the world (Steg et al., 2012). Together, they influence how individuals react to the environment. However, the assumption is that individuals are capable and willing to process all available information in order to make a decision that suits their needs best. Unfortunately, rationality in human decision-making is often absent. The basis of this problem is founded on different principles. In general, individuals are likely to keep what they have, they are oriented on the present, and they are sensitive to concrete information in their decision-making process. The decision-making process is not only based on rational behaviour. Rather, there are two systems in the mind which affect the processing of information for choice behaviour. This dual model comprises an nonconscious, automatic system, and a conscious, deliberative system. These systems are also referred to as system 1 and system 2 (Kahneman, 2011). Often these systems also work synergistically. System 1 depends on the activation of mental concepts and automation to perform behaviour. Automation is a method of learning that transforms a process that requires active attention into a habitual automatic process. Specific skills and choices can be automated if they are repeated often. When an individual chooses the same option over and over again, not only the action, but also the choice will be automated. Automation saves time and energy in the mind, since the nonconscious system is much quicker and more efficient than the conscious system. Moreover, this system can process many things simultaneously. Yet, looking rationally, the choice made within the nonconscious, automatic system might not always be the best option. The unavoidable conclusion is that it matters how a choice is presented, because this can largely influence which option an individual chooses. This influence is unavoidable, because choices always have to be presented in some context. Therefore, until a certain extent, our behaviour is merely a reflection of the situation in which we are located. To effectively influence individuals' behaviour, the nonconscious determinants of behaviour need to be studied, whose effects have so far remained underestimated (House of Lords Science and Technology Select Committee, 2011; Tiemeijer, 2011).

Because thinking about behaviour change has so far focused on the conscious, deliberative cognitive system, most traditional interventions take this route, based on the presumption that individuals will analyse the information and act in a way that reflects their best interests. Methods based on the conscious system include financial, informative, and legislative interventions. However, as explained previously, these perfectly rational decisions are not always made. The contrasting model of behaviour change focuses on automatic cognitive processes. This creates a shift in focus away from

facts and information, and towards altering the situation or context in which people act. This might be called the 'context' model of behaviour change, which recognises that sometimes, people are irrational and inconsistent in their choices, often because they are influenced by their surroundings. This paradigm has so far received far less attention (Dolan et al., 2010).

Since the nonconscious system processes all available stimuli that are present in an environment, and it perceives multiple sensory channels simultaneously, it is necessary to focus attention. Cognitively, attention can be described as the process of selectively concentrating on certain aspects of the environment whilst ignoring other things. Habits are formed, which are cognitive structures that automatically determine behaviour by linking specific situational cues to behaviour. These simplify the cognitive processes even further (Steg et al., 2012). However, at the time of perceiving, the individual is also a part of the environment itself, influencing and changing its surroundings. Accordingly, the environment is continuously changing, and therefore attention shifts and the activation of behaviour changes as well (Baroni, 2003).

02.3.2 NORM ACTIVATION

The norm-activation model proposes that environmental action follows from the activation of norms. As described before, these norms can be activated in the mind by elements within the physical environment. When activated, goals guide large sets of behaviour and affect cognitive processes in order to achieve the goals. There are three main overarching goals, namely normative goals, gain goals, and hedonic goals. Normative goals decide how and when to behave appropriately. Gain goals are focused on maintaining and improving one's resources. Finally, hedonic goals aim to improve how an individual feels right now. The activation of a goal is the extent to which a mental construct and its motivational components is accessible at a certain moment (Steg et al., 2012). A goal frame affects the way in which people process information, and how they behave upon it. When the activated goal changes, the perception of a situation will also differ (Lindenberg and Steg, 2007).

However, activated goals are rarely completely homogeneous. Often they are mixed, and the performed behaviour is a result of the currently activated goals. Individuals have a wide range of mental concepts at their disposal, which can all influence behaviour. On any given moment, most of these concepts are latent, and only a small part is active. Different actions require the activation of different mental concepts. Simultaneous activation of different concepts can lead to conflict. Moreover, the social environment also contributes to activating norms. The presence of other people is often enough to activate social norms, and therefore the group context is very important. Individuals that live within a cohesive social group are often more likely to conform to social norms (Lindenberg and Steg, 2007).

Finally, norms can also be deactivated. Seeing a specific anti-normative behaviour can lead to general anomie, and it will negatively influence conformity to other norms and rules (Cialdini et al., 1990). It follows that signs of inappropriate behaviour in the environment will lead to more commonly occurring unwanted behaviour. This is referred to as the cross-norm-inhibition effect (Keizer et al., 2008).

02.3.3 SCRIPTING AND SCHEMA

Due to the isomorphism between behaviour and the environment, the design of the environment consolidates desired behaviour patterns. The script-based approach is a theoretical perspective that understands habits as behavioural scripts that link triggering cues to stereotypical sequences of behaviour. It assumes that the consistent pairing of situational cues and behaviour leads to the development of behavioural scripts, which are memory structures storing a blue-print of the relevant behaviour. Therefore, the script is a mental representation of a sequence of acts that is based on a previous experience (Steg et al., 2012). These scripts consequently pair situational cues and behaviour, and therefore behaviour is recalled and repeated when the script is encountered again. A script contains the sequence of acts that is usually performed when relevant situational cues are detected, and that has led to successfully obtaining the respective goal before (Verplanken and Aarts, 1999). This perspective considers habits as principally goal-directed, which means that a goal is usually activated first deliberately before automaticity in form of a script partly or completely takes over by defining the sub-steps to reach this goal. Habits are considered to be automatic links between goals and actions (Aarts and Dijksterhuis, 2000).

Thus, it is assumed that objects can obtain agency, as the script embedded in the objects carries a message. Through scripting, human agency can also be embedded in non-human objects, which are supposed to perform the script, influencing the behaviour of its users. Thereby, objects acquire the power to make humans acts and react, and behaviour is induced through artefacts. By scripting material objects, behaviour can also be designed. Moreover, unfamiliar environments are evaluated and learned more rapidly if the stranger is primed with a schema name that relates new experiences to previous ones. When applied to the environments, labels (like bazaar, leisure resort, business district) prime people what to expect, how to dress and how to behave. If a visit has a script, it is recalled better (Baroni et al., 2003).

The social setting is determined by the physical setting, and both have to be congruent to create a synomorphy in the landscape. This indicates a high degree of fit between a behaviour setting and the

individuals within it. Many socio-spatial environments are behaviour settings, containing a great deal of objects that together form a specific environment within which consistent, prescribed patterns of behaviour and activities have become routinised. There tends to be a fit between an environment and the behaviour that is performed within it. The setting provides information about the behaviour to be performed by the individuals within it, and it determines the range of behaviour that is possible within it (Cassidy, 1997; Gifford, 2007). Therefore, the user has to acquire schema, that become inseparable from the physical layout. Each of these schema is represented both cognitively and physically, as a set of physical objects and spaces, social systems, and settings for particular events. A schema combines all of these into an economical package that can be accessed quickly in the mind. Thus, a schema is comprised of more information than a script. The former is focused on an entire environment, whereas the latter is focused on the agency of a single object. Much behaviour is therefore regulated by the environment, which shapes our actions. Recent activation increases the likelihood and speed of subsequent access to a schema and hence decisions about appropriate action (Lee, 2003).

Schema are inferred from observations that perceivers construct in their own reality. They are a knowledge structure, built though the assimilation of stimuli. It can be applied to any feature of the environment, both physical and social, that assumes significance for an individual. Thus, it aids the active process of seeking for meaning in the environment, as schema store representations of the past and provide templates for future behaviour. Schema can make new environments meaningful based on previous experience. The concept of schema helps to explain how people construct representations in their memory, and how they process, interpret, and understand streams of information. Schema are not static knowledge structures, they develop organically. Therefore, there is a possibility to reconstruct schema. Practically all schema include a spatial referent. Schema include socio-spatial stimulus configurations, detailing what an object is, where it is, and when it is available. The built environment is essentially isomorphic with the social system that is deployed within it. Therefore, human environments cannot be perceived as physical objects in isolation from social and behavioural implications and activity patterns. Schematisation is thus what unites the physical context and behaviour (Lee, 2003). Action or event schema become active when an environment is cognitively placed within a certain category, thereafter running off an action sequence resulting in behaviour. Through experience, individuals acquire schema about what to do in different situations. This combines spatial knowledge with social knowledge (Lee, 2003).

There are four main components included in a schema, namely the cognitive component, the affective-emotional component, the behavioural component and the evaluative component. The cognitive component contains information on an environment as belonging to a certain category in

the mind. The affective-emotional component consists of the individual's emotional reactions to a certain type of environment, based on personal history. The behavioural component involves information on behaviours that might effectively be carried out in this type of environment, considering the aims and motivations of the individual. Finally, the evaluative component concerns the evaluation an individual makes of the environment, with respect to each of the other components (Mainardi Peron and Falchero, 1994).

Environmental items can be grouped into four categories, according to their relationship with the schema. Firstly, the presence of schema-expected items is expected based on the activated environmental schema. These items are necessary for the definition of the schema. Secondly, schema-compatible items are present and compatible with the schema, but not necessary to define the schema. Thirdly, schema-irrelevant items may or may not be present, and they do not help the individual decide about the activated schema. Finally, the presence of schema-opposed items is in contrast with the activated environmental schema (Baroni, 2003).

02.4 PRIMING

Priming theory explains how the environment can activate specific norms nonconsciously. Thus, it also explains how nudging could work. Priming has a strong empirical basis and is therefore an established theory that can assist the understanding of behaviour change.

02.4.1 THEORETICAL ANALYSIS

Priming is the activation of mental concepts in order to make these concepts more easily accessible. Thus, primes come to influence our decisions and behaviour (Tiemeijer, 2011). Karl Lashey was the first to use the term priming to refer to the activation of response tendencies in a 1951 article. He argued that there has to be a mediating state intervening between intention and the production of this intended behaviour. This mediating state functioned to assemble the action into the proper serial sequence, which he called the priming of response. Thus, the idea of priming entered the literature to indicate a preparedness of mental representation to serve a response function, even though Lashey described an intentional source of the activation (Bargh and Chartrand, 2000). Bargh was the first to discuss primes as an nonconscious behavioural stimulant. Priming research was used to demonstrate that activating a construct in the mind is sufficient to elicit behavioural effects. The auto-motive model of nonconscious goal pursuit argues that goals can be nonconsciously activated by features of the context or environment in which they are pursued, in which the environment

serves as the prime for the resulting behaviour (Bargh et al., 1990; Bargh et al., 1996; Gollwitzer and Bargh, 1996).

Primes can include anything that is sensory, hence also including characteristics of the physical environment. The psychological mechanism behind this phenomenon is the ideomotor-principle, which indicates that thinking about a certain behaviour improves the chance that this behaviour is performed. Because priming activates the mental construct of a behaviour in the mind, the chances of that behaviour being performed increase (Tiemeijer, 2011). Yet primes alone are not sufficient, and they must be in line with environmental cues in order to elicit effects (Doyen et al., 2012). Through the ideomotor-principle, primes in the environment can affect behaviour by activating mental concepts. Individuals are usually unaware of priming effects, and therefore it is a form of nonconscious influence. Kay et al. (2004) argue that since semantic primes and person primes have been shown to exert effects on behaviour via increasing the accessibility of relevant cognitive constructs, it is reasonable to predict that nonconscious exposure to objects should produce similar effects. Implicitly presented material objects can trigger automatic processes increasing the cognitive accessibility of mental constructs. The presence of everyday, inanimate objects can serve as "material primes", that exert automatic, nonconscious effects on behaviour choices and judgements.

Certain material objects are associated with particular social contexts. These objects play an important role in creating distinctive environments that communicate behavioural norms (Kay et al., 2004). Priming effects occur because people learn to associate environments and their related concepts and contexts to specific perceptual and behavioural patterns (Bargh, 2006). Automatic associations help people understand which actions are appropriate in specific situations (Aarts and Dijksterhuis, 2003). Priming-effects are stronger when individuals value the activated goal higher (Tiemeijer, 2011). From an automatic priming perspective, the connotations of environments will affect interpersonal interactions, because the environmental cues activate learned behaviour and social norms. Therefore, the behaviour of individuals is affected by their surroundings. Behaviour settings are created, in which people's behaviour is subject to the norms and arrangement of the physical environment. The theory of behaviour settings relies on the previously mentioned schema theory. Behaviour settings theory can be understood as environments that are associated with cognitive scripts, determining sequences of behaviour in a given social setting. Previous experience with an environment thus result in mental schemas that are primed by this environment (Peña and Blackburn, 2013).

Activating a trait construct is sufficient to elicit behavioural effects in the absence of awareness (Doyen et al., 2012). Moreover, priming can aid the understanding of novel situations. If objects are

embedded in these contexts that have been encountered before, the legibility of these environments increases. If certain objects come to assume implicit meanings, exposure to such objects may increase the cognitive accessibility of related constructs, improving the disambiguation of the context and affecting behavioural choices (Kay et al., 2004).

02.4.2 APPLICATION

Bargh and Chartrand (2000) have published a guide to priming research, demonstrating the methods commonly used to explore cognitive processes that mediate between environmental events and human behaviour. They describe priming studies to be concerned with effects of the current situational context and how these environmental features cause the average individual to think, feel, and behave. Priming studies are concerned with the temporary activation states of an individual's cognitions and how this internal activation interacts with environmental information to produce perceptions, evaluations, goal pursuits and social behaviour. They argue that priming techniques can be used to research influences of the environmental context on behaviour. Bargh and Chartrand illustrate three experimental techniques that fall under the umbrella of general priming research. Firstly, conceptual priming is a method that involves the activation of mental representations in one context, in order to exert an influence in subsequent, seemingly unrelated contexts. This technique includes trait concept priming, used to affect internal characteristics of individuals. Secondly, in mind-set priming participants are actively engaged in a goal-directed type of thought in one context, to research if this mind-set is likely to operate later in an unrelated context. Thus, what is primed in a procedure or way of thinking about information or a specific situation. An intentionally pursued goal is transmitted to another context, and therefore intention and awareness play a greater role in this type of research. Thirdly, sequential priming tests for connections between two mental representations. Therefore, this method can be used to study the associative structure of the mind. Analysing these three methods, it can be argued that in this thesis the methodological focus is either on conceptual priming, because it aims to investigate the nonconscious influence of environmental primes on subsequent behaviour. One of the main techniques within the method of conceptual priming is the scrambled sentence test.

So far, only a few studies have investigated the effect of the physical environment on behaviour through priming research. However, the method is founded in a larger research field where semantic primes and person primes have already been shown to affect behaviour. Priming has been used for example to activate concepts of old age (Bargh et al., 1996; repeated by Doyen et al., 2012), performing well and cooperation (Bargh et al., 2001), achievement (Ferguson and Bargh, 2004), and littering behaviour (Cialdini et al., 1990). Nevertheless, none of these studies focus on priming effects

of objects or environments. Four studies have been found that do research this effect. They refer to is as material priming, contextual priming, environmental priming, or merely priming. In the following paragraphs, the studies are discussed chronologically.

Aarts and Dijksterhuis (2003) study the capability of two different environment to activate mental representations of normative behaviour through three experiments. In the first two experiments, the symbolic representation of a library environment is tested to activate mental representations of silence and consecutive silent behaviour. In the final experiment, an exclusive restaurant environment is used to influence mannerly behaviour. Before executing the experiments, pilot studies were used to investigate if the discussed environments actually relate to the expected activations and behaviours. This was the case. The first main experiment was carried out by measuring the response latency towards different pictures of environments. The second experiment investigated whether the priming effects indeed lead to changes in behaviour by measuring the intensity of participants voices. In the third experiment, the priming effects are replicated in a different environment, namely a restaurant instead of a library.

Kay et al. (2004) study if implicitly presented material objects common to the domain of business will increase the activation of the concept of competition. Participants were primed with these objects, and thereafter asked to answer questions about how cooperative they felt towards social interaction, and the amount of money they retained for themselves in the “Ultimatum Game”. Thus, the importance of material primes on behaviour is discussed.

Berger et al. (2008) study whether assigned voting locations influence how people vote. This is done by analysing election results from the 2000 general election for the state of Arizona. Predictions indicated that voting in school would increase support for raised education spending. In a control study, pictures of different voting environments are shown, and randomly assigned participants were asked to vote in a seemingly unrelated study. Results indicated that participants were more likely to support school funding initiatives if they had been exposed to school environments.

Peña and Blackburn (2013) study if exposure to social settings can bring to mind social behaviour. They study the perceived warmth and formality of a virtual library and a virtual café. Sets of participants were instructed to get to know each other, and they were given one hour to converse in the virtual environment. Following the interaction, the participants completed various tests related to their self-perception and partner perceptions. Also, the texts messages were analysed to research the acquaintance.

In all cases, a thorough debriefing was applied to investigate whether or not the participants were aware of the priming task. Debriefing is often performed in a funnelled debriefing procedure, in which the experimenter asks the participant questions about their awareness of the purpose of the experiment, increasing the specificity of the questions.

02.4.3 DISCUSSION

It has been argued that environmental stimuli can influence social perceptions, decision processes, and behaviour. However, despite the abundant research on semantic priming effects, person priming effects, and their related implicit processes, the extent to which potential sources of priming include physical objects in a specific environmental context remains unclear (Kay et al, 2004). Early research has been performed in a laboratory setting, where the potential for generalisation to the actual environment remains under debate. The validity of these experiments is also compromised by the presence of the researcher, who may influence the results of the experiment (Doyen et al., 2012). On the other hand, research by Peña and Blackburn (2013) has been performed in virtual environments, investigating how these prime subsequent interpersonal relations among unacquainted individuals. They argue that connotations related to different environments affect interpersonal relations, but it is unclear if and how these results can be applied in non-virtual environments. However, in the real environment, it is never certain which prime elicits a specific behaviour, since behaviour is context-dependent and affected by a great deal of influences simultaneously. Additionally, since priming occurs as an automatic process, it is likely that individuals are unaware of the influence of the environment on their behaviour.

Still, it seems likely that in novel or ambiguous situations, perception can be influenced by environmental material cues, since individuals do not possess a clearly established cognitive script and therefore they need to rely on other means (Kay et al., 2004). Understanding the influence of material priming can assist in future physical environments. Moreover, much research has been done into this mode of priming over the last twenty years, and the thoughts and behaviours that are thought to be influenced by priming is still growing (Tiemeijer, 2011).

02.5 ENVIRONMENTAL CUES

The theory on environmental cues discusses how objects and environments can serve as cues that nonconsciously elicit behaviour. Therefore, environmental cues could serve as nudges. It is founded upon norm activation theory and therefore grounded in broader understanding of the mental system.

02.5.1 THEORETICAL ANALYSIS

Environmental cues are all of the sensory cues that exist in the environment. They are elements in the environment that convey information or trigger an affective reaction, and therefore seeing such a cue is likely to influence behaviour. Since human behaviour always takes place in a certain environment, environmental cues are all around us. Environments are never merely neutral. In each of these contexts, there are different social norms relevant, and their applicability is communicated through the physical surroundings (Lindenberg, 2013; Steg et al., 2013). The mechanism behind the effect of environmental cues is based on norm activations as described previously. Environmental cues can strengthen or weaken the activation of goals, thus influencing what people think, what information they are sensitive to, what action alternatives they perceive, and consequently how they will act (Lindenberg and Steg, 2007).

Through environmental cues, the physical environment exerts influence of people's behaviour through material signs. Human behaviour is always performed in a specific location, with its unique design and characteristics. These environments are connected to schema, conveying ideas about which behaviour is deemed appropriate in a certain environment. Therefore, every environment exerts cues that are relevant for behaviour. Thus, every environment can also be said to have cue power, comprising the capability to change behaviour (Tiemeijer et al., 2009). With directed attention, an environmental cue can become an attended cue. Often, environmental cues are assimilated nonconsciously. They serve as the primary context that shapes how the world is perceived. As such, they can prime prior experiences, that influence decision-making and thus behaviour (Lindenberg, 2013). Goals only influence behaviour when they are sufficiently activated in the mind. Activation of mental constructs can happen in reaction to an external cue, which can be found in the physical environment. The process of activation often happen nonconsciously (Tiemeijer et al., 2009). Cues in the environment that show support for norms can directly increase the relative strength of the normative goal. Cues in the environment that suggest the presence of significant others who respect situational norms are likely to strengthen normative goals (Teasdale and Silver, 2009). Therefore, empty environments are also in danger of leaving the activation of normative goals at a low level, which can increase the chance of deviant behaviour (Steg et al., 2013). Environmental

cues encourage individuals to behave a certain way or engage in certain actions, also depending on how those around them respond to cues (Lindenberg, 2013).By understanding and implementing environmental cues, the strategic design of the environment can offer an alternative steering method for behaviour. Hence, environmental cues play a role in mediating the behaviour of individuals.

02.5.2 APPLICATION

In environmental cue theory, many examples of automatic behaviour change are mentioned. However, none of these examples use the term environmental cues explicitly. Therefore, these examples are discussed in other chapters, e.g. in the chapter on priming.

02.5.3 DISCUSSION

Three main issues surround the concept of environmental cues. Firstly, its trustworthiness can be questioned, since very few authors have used the concept. Also, one of the proponents of the concept is the disputed scientist Diederik Stapel, renowned for forging data in his research. Still, the phenomenon seems to exist and corresponds with a *nudge* as proposed by Thaler and Sunstein. Secondly, empirical research is lacking. Thirdly, the term environmental cue seems to be interchangeable with the term contextual prime, which has been much more extensively researched. Therefore, the necessity of the term is questionable. Environmental cues are linked to many other theories in the field of automatic behaviour change. The mechanism that is the foundation of the cue power effect is the automatic activation of mental concepts as described by Bargh et al. (2001). On the other hand, the strong links between environmental cues and other theories do indicate relationships between the different concepts that currently exist. There is an especially strong link between environmental cues and the ideas of schema and scripting, which are seen to motivate the particular behaviour as discussed in this thesis. Therefore, in the context of this thesis, the concept of environmental cues is a strong and highly relevant concept, and therefore it will still be used.

02.6 COMPARE AND CONTRAST

Debates around the definition of concepts and their application have been laid out, and these similarities and differences will be used to draw this comparison. After a quick summary of the theories, their abstraction level, object of study, current attention, and amount of attention are compared. To summarise the beforementioned theories, they are quickly recapitulated below. Affordances are perceived possibilities for action in the environment. Therefore, affordances indicate

the relationship between humans and their environment, describing the behaviour that an environment affords an individual. Priming is the nonconscious activation of mental concepts, through primes that relate to these concepts. Environmental cues are primes within the environment that trigger a certain reaction through the activation of a mental concept. Finally, nudges are interventions that prompt a specific choice.

The theories differ in the extent to which they concretise their concepts. The concepts surrounding the theory of environmental cues are very abstract in their description and they have not been applied to concrete cases. Affordances describe a relatively abstract concept, since the term describes a relationship rather than a physical environment or behaviour, but much research has been aimed at empirically investigating this relationship, making applied research readily available. Nudges have a clear description of applications of the theory, leading to potential interventions. Nudging theory is thus very concrete. Likewise, general priming theory has been empirically tested, creating clarity around the application of the concept. However, priming theory focused on the environment has not been tested extensively, and therefore the concept of environmental cues remains an abstract description of the mental process of norm activation through primes in the environment.

Moreover, the different theories describe their object of research in slightly different ways. The initial concept of affordances is focused on a human-object relationship, neglecting the stimuli-rich environment within which the object is almost always placed. Priming theory has been applied to a great deal of cases, and therefore it has attempted to describe the relationship between individuals and words, pictures, other people, objects, situations, contexts, and environments. Environmental cues are based on priming theory, but they only describe the relationship between humans and spatial elements, namely objects or environments. Finally, nudges indicate the relationship between humans and their environment, which it defines as the choice architecture.

When it comes to current attention towards the topic, an analysis of the dating of the different sources that have been used indicates the following results. As was to be expected, the theory of affordances has received attention since 1977, and the last sources that have been used date from 2003. However, affordance theory is still a leading theory in the current approach towards behaviour change paradigm. Therefore, after its initiation in 1977 by J.J. Gibson it has received attention by plenty of other authors. Priming has started to gain traction in 2000, but is still current. The last sources used in this thesis date from 2013. It has received a great deal of attention across many theoretical fields, but five authors have been found that investigate the spatial application of the theory. Likewise, the concept of environmental cues is also still current, but this theory only

commenced to be introduced around 2007. Also, only two authors have investigated this concept. Finally, the theory of nudges has been coined by Thaler and Sunstein in 2008 and has since received attention. Apart from its two initiating authors, the concept has been object of polical debate but it has also received some scientific attention. Thus, priming, environmental cues, and nudge have all received current attention in the field. The theory of affordances is more dated but still remains current, and it serves as one of the foundational theories of the current paradigm.

All theorists agree that the mechanism upon which the theories are founded is the automatic activation of mental concepts, however, the described relationship and depth of the relationship between the physical environment and behaviour differs. All theories believe that behavioural choices can be imposed by the physical environment, and that objects and the environment have the agency to influence behaviour. Therefore, they all agree that the environment carries a message about behavioural norms, and that this message can be placed by the designed. However, none of them believe in environmental determinism, the paradigm that has been predominant previously. These theories all describe a form of environmental probabalism, in which the environment plays a role in determining behaviour, but individuals are not obliged to adhere to these norms. However, the theories differ in their approach towards the topic. The theory of affordances is a foundational theory, introducing the idea that the relationship between humans and their environment can be seen as an affordance, defined as a possibility for action which the environment affords to an individual. Priming theory elaborates upon the theoretical background of behaviour change through cues in the environment, by explaining how the concept works when it is operationalised. Primes have been shown to exert effects on behaviour via increasing the accessibility of relevant cognitive constructs. This approach is founded upon semantic priming, but recent studies into environmental cues have described the concept as a contextual prime that can influence behaviour through norm activation. Priming theory explains how the environment can activate specific norms, and the theory of environmental cues is comparable to contextual priming, but explains the mechanisms more in-depth and focused on goals of the individual, thus connecting it to both environmental and behavioural theory even further. Finally, the nudging theory exposes the practical application of these approaches, setting forth examples, research, and policy which highlights potential interventions that affect behaviour.

02.7 CONCLUSION AND HYPOTHESES

The literature review provides theories that offer very good reasons to assume that nudging is indeed a concept that might work in practice, and can indeed be applied to alter behaviour of individuals in public space.

The previous paragraphs have discussed existing theoretical approaches towards automatic behaviour change. Each of the theories commences by presenting key authors in the subject, setting forth the main points of the theory. Thereafter, the section on applications sets forth different methods that are adopted by previous authors using the theory. Finally, discussions and debates surrounding the theory have been elaborated upon. The presented theory provides an overview of current literature on the topic of human-environment relationships and automatic behaviour change, which may explain how nudging functions theoretically.

03. METHODOLOGY

From the literature review it can be concluded that the idea that behaviour can be influenced by altering the physical environment has gained traction in policy and is supported by scientific literature, but empirical evidence to support this idea is limited. Given the theoretical framework as described in this thesis, an experiment will be performed.

On the Wageningen University campus, an intervention will be created, intended to alter pedestrian movements. The effect of this intervention on behaviour will be studied in a quantitative manner, through observation. This empirical research provides tentative insight into the workings of the concept of nudging. It aims to illustrate the claims made in *Nudge* by Thaler and Sunstein (2008) with an initial investigative study in the form of a field experiment. The following hypotheses are a tentative explanation of the expect result of the intervention, based upon the theory in the literature review. The proposed hypotheses are:

H_0 the *placement of lines* that act as an environmental cue to indicate a default path *will not lead* to more people choosing this behaviour and less people choosing the alternative behaviour.

H_a the *placement of lines* that act as an environmental cue to indicate a default path will lead to *more* people choosing this behaviour and *less* people choosing the alternative behaviour.

Interventions need to be carefully planned before they are implemented (Steg and Vlek, 2009). Using a theory-driven approach towards behaviour change is important as it will provide a good basis for understanding, changing, and evaluating behaviour (Steg et al., 2013). Therefore, the research is based on previous methodological approaches (chapter 03.1) and the intervention is modelled after a typological analysis of existing nudges (chapter 03.2). A more detailed description of the experiment, of the study area, and the intervention can be found in chapters 03.3 through 03.5. In the subsequent chapters, the data collection and analysis are elaborated upon. Finally, the limitations of the research design are discussed.

03.1 PREVIOUS METHODOLOGICAL APPROACHES

Through the literature review, the different methods applied in previous studies have been put forth. They can provide an informed background for the current intervention. They serve as inspiration, to look back upon how other researchers have studied similar subjects.

Within affordances theory, research is generally carried out through focus group discussions, rating scales measuring perceived and actual boundaries of gap-crossing, measuring water consumption after different interventions, or measuring the number of items in a wastebin after an intervention (see e.g. Clark and Uzzell, 2002; Prieske and Withagen, 2015; Kyttä, 2002; Seyranian et al., 2015; Duffy, 2009). All of these, except for the focus group discussion, focus on measuring an observable indicator in the real world. Within priming theory, this thesis focuses on conceptual priming. Bargh and Chartrand (2000) have published a guide to priming research. In this particular field, investigations are generally made using a scrambled sentence test or similar semiotic tests (see e.g. Bargh et al., 1996; Doyen et al., 2012; Bargh et al., 2001; Ferguson and Bargh, 2004; Cialdini et al., 1990). Applications in spatial environments include measuring the capability of different environments to activate mental representations by measuring response latency and intensity of voices (Aarts and Dijksterhuis, 2003), the influence of objects on competitive tendencies by playing a financial game (Kay et al., 2004), the influence of voting location on voting behaviour by measuring support for school funding initiatives (Berger et al., 2008), and the influence of a virtual library and a virtual café on social behaviour by measuring word-count and a self-perception test (Peña and Blackburn, 2013). Within the theory of environmental cues, no empirical research has yet been carried out. Finally, within the nudging theory, applications focus on applications in healthcare, lifestyle and obesity (Hollands et al., 2013), retirement and health insurance choices, traffic safety, security, and sustainability and environmental conservation. Many applications of nudges have been described and reported to cause effects, but many of these investigations have not been made through research in scientific journals and therefore their reliability can be questioned (also see appendix A).

It can be concluded that the foundational theories within the conceptual model have been extensively tested. However, the concepts of environmental cues and nudging have not, possibly due to their relative novelty in comparison. All theories employ methods of observation or measurement of occurrences in the environment, and therefore choosing a method of observation for the current study can be argued for based on previous research. Field experiments are applied in current practice in order to evaluate interventions (Steg et al., 2013) and are therefore suitable for this investigation. The benefits of a field experiment in this empirical research are elaborated upon in the following paragraph, whereas its limitations are discussed at the end of this chapter.

03.2 TYPOLOGY OF NUDGES

The chosen intervention is based on an analysis of existing nudges. In order to delineate the practiced field of nudging and investigate what potential is set forth by the different applications that have been discussed so far, a typology of nudging interventions has been created, founded in the literature review. This typology is used to decide what kind of intervention will be tested in practice.

There are three main reasons for advocating the use of theory in designing interventions in the environment. First, interventions are likely to be more effective if they target causal determinants of behaviour and behaviour change; this requires an understanding of these causal determinants, which are the theoretical mechanisms of change. Second, theory can be tested and developed by evaluations of interventions only if those interventions and evaluations are theoretically informed. Third, theory-based interventions facilitate an understanding of what works and thus are a basis for developing better theory across different contexts, populations, and behaviours. Without a theoretical basis, even a large literature on behaviour change interventions may offer no guidance on how to design an intervention for a new situation. Therefore, there is increasing recognition that interventions to change behaviour should draw on theories of behaviour and behaviour change in their development. Developing and evaluating complex interventions starts with a theory phase, before progressing to modelling and experimental phases (Michie et al., 2008).

It seems there are different types of nudges that can be implemented in the environment, based on the examples found in literature and practice. They will be shortly discussed in this paragraph. However, for explanations and references of all the interventions, see appendix A. Firstly, the design properties of the environment can be altered to cater for more legibility and facilitate the correct use of the environment. The functional design of the environment can be adapted, see for examples intervention number 10 (fly in the urinal), 18 (light socket), 20 (change thermostat settings), 21 (change printer settings), and 32 (wastebin design). These interventions relate to the basic principles of choice architecture, namely understanding mappings, expect error, defaults, and structure complex decisions. Also, design can affect the ambience of the environment, for example through making aesthetic improvements or deploying light, colour, and sound to affect behaviour. For examples, see intervention number 4 (dynamic lighting), 13 (relaxing music), and 25 (music product choice). They relate to the basic principles of incentives and understand mappings. Furthermore, an intervention can provide generalised or personal feedback, employing type 2 nudges in order to alter behaviour. Examples can be found in interventions 1 (comparing energy use), 2 (driving game), 5 (speed smiley), 8 (turn off the light), 31 (calories on steps), and 35 (mirrors and cameras). This relates to the basic principles of giving feedback, understanding mappings, and defaults. The availability or

proximity of ‘good’ choices can also drastically influence the behavioural decisions that are made. Availability refers to the ‘good’ possibilities that are present, and related to decreasing ‘bad’ options. Proximity refers to the placement of ‘good’ options. Examples can be found in intervention 6 (restricted smoking areas), 14 (organisation of cafeteria or shop), and 16 (building organisation). They relate to the basic principles of defaults and simplifying strategies in order to structure complex choices. It is also related to sizing, where properties of objects are made more visible or accessible. Finally, prompting employs hedonic or gain motivations in order to stimulate behaviour. Examples are found for example in interventions 3 (green footsteps) and 11 (posters). These relate to the basic principles of choice architecture that are founded in incentives and defaults.

Therefore, it can be concluded that there are five main themes around which nudging interventions in public space can be grouped. This creation of this typology is based upon Hollands et al. (2013), who have proposed a typology of nudging interventions in health sciences. Nudging interventions can be grouped around five themes, namely:

- Functional design
- Ambience
- Feedback
- Availability and proximity
- Prompting

Functional design signifies the potential of the design of objects within the environment and the environment as a whole to influence people’s behaviour. Ambience refers to the mood or feeling of a particular place, which has the potential to affect behaviour by changing the perception of users. Feedback concerns the possibility of the environment to provide feedback towards its users, thereby implicitly changing their behaviour for the better. Availability and proximity relate to the placement of objects and the organisation of the environment, which can have a tremendous effect on resulting behaviour. Finally, prompting refers to addressing the intrinsic motivations and goals of users in order to alter their behaviour.

These interventions are founded in the basic principles of choice architecture. The principles that are often applied in spatial interventions include defaults, giving feedback, and simplifying strategies. Defaults are the most spatial in the sense that they can be deployed to stimulate people to take the option that offers the least resistance. They are applied in every intervention theme and guide the behaviour of their users. Giving feedback is an important mechanism as it can activate behaviours based on context-based experience and temporal settings. Simplifying strategies can be employed to structure complex decisions, thereby easing the decision-making process.

In the present experiment, prompting has the most potential to be tested in the public environment, since it is the intervention that is easiest to realise in the public space on campus. The other four types, namely functional design, ambience, feedback and proximity require larger alterations of the environment and are thus not manageable for me. Therefore, the intervention will be of the prompting type. As a nudge, a marking is placed on the floor, intended to highlight the fastest route and diminish over choice stress.

03.3 EXPERIMENTAL DESIGN

The empirical research is an experiment, since it aims to investigate a cause-effect relationship. Moreover, it is a field experiment, since the object of research is nonconscious behaviour.

The experiment is designed as follows:

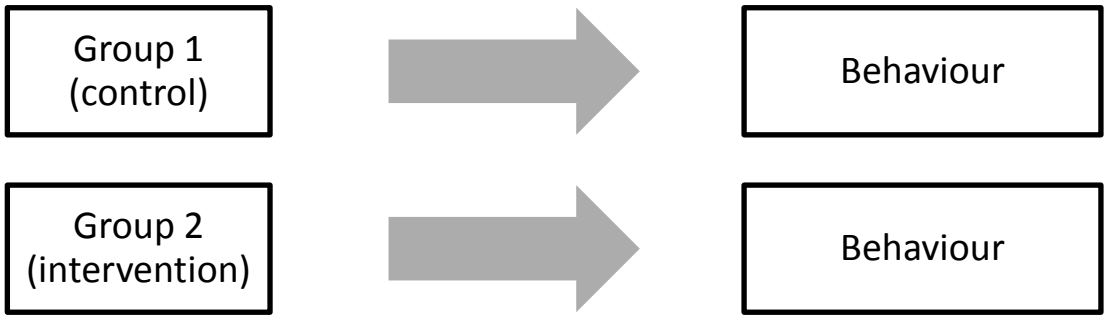

Figure 1: Experimental design

By comparing the behaviour of group 1 and group 2, the effect of the intervention is investigated.

In this research, a single environment is examined with an without an intervention. It is an experimental design, which intends to explore the application of nudging theory in a spatial sense. Ideally, intervention studies include measurements of behaviour before and after implementation of the intervention, a so called pre-test/post-test design, and include a control group that has not been exposed to the intervention. Also, including measurements of factors related to behavioural decisions is important, as this will provide insight into the reasons why an intervention was effective (Steg et al., 2013). This experiment therefore includes one case and observations, but no comparison or control group to act as a benchmark (Sirakaya-Turk et al., 2011). In the current research, it is hardly possible to find a similar control case. However, since the landscape is rather static, little change is likely to occur over the span of a month so it can be assumed that behaviour will remain the same over time without the intervention, and will only change after the implementation of an

intervention. Therefore, no control condition is necessary, since it is improbable that large changes will take place during the execution of the experiment. Thus, the before situation also acts as the control situation.

The experiment is a research method that measures the effect of an independent variable on a dependent variable. It is conducted in a naturalistic setting and requires manipulation of independent variables across different experimental conditions (Nagar, 2006). It therefore provides insight into cause-effect relationships. In this research, experimentation is a primary means of understanding how individuals interact with their environment. It can yield information about the relationship between a specific intervention and the resulting behaviour, by keeping all variables constant except for one. Landscapes, however, are by definition highly integrated systems where precise predictions can be difficult to make, because multiple causations are often at the foundation of change, and therefore definitive results are obscured. Experiments at the landscape scale must therefore deliberatively manipulate environments in order to examine the influence of one or more aspects of landscape composition on behaviour (Holt and Bowers, 1999). Specifically, this empirical research takes on the form of a field experiment, in which the independent variable is manipulated in a real-life setting.

The present research is conducted in a real environment. Individuals and their environments complement each other, and therefore studies on individual behaviour should be conducted in natural environments rather than in isolation (Gibson, 1979). This is an absolutely necessary constraints if the aim of the research is to say something about the person-environment relationship, which is intended in this thesis (Baroni, 2003). Behaviour in a field experiment is more likely to reflect real life because of its natural setting, and therefore the ecological validity is higher than in a laboratory experiment. Therefore, one of the main strengths of the present research is its high external validity. A field experiment enhances the external validity and experimental realism because it is set in an existing environment (Nagar, 2006; Steg et al., 2013). The internal validity can be somewhat maintained when the experimenter attempts to take control over the situation by systematically manipulating independent variables, and by trying to randomly assign participants to different study conditions. By doing so, researchers can be reasonably sure that any differences between conditions are due to the manipulating, thus partly securing internal validity. Nevertheless, because field studies take place in real settings, it is difficult to control for possible confounding variables, such as changing weather conditions or unexpected interruptions. Furthermore, in many situations, random assignment is not possible (Steg et al., 2013). Moreover, there is less likelihood of demand characteristics affecting the results, as participants are not aware that they are being studied due to the covert nature of the study. Because the experiment investigates automatic

behaviour, it is difficult or perhaps impossible to ask the target group questions about their behaviour, which is likely to occur due to nonconscious processes. Observation investigates the direct effect of an intervention on behaviour. Additionally, field experiments are replicable. Through this reasoning, a quantitative approach is justified.

03.4 CONTEXT AND ANALYSIS OF THE SITUATION

The research is conducted on the Wageningen University campus in February 2016. The objective of this investigation is to alter the flow of pedestrian movement through space by implementing a nudge intervention. This experiment investigates the potential of floor markings to alter movement. Floor markings addresses the ability of interventions to shape behaviour and investigates how the proposed intervention affects behaviour in space, thus tentatively examining the proposed conceptual mode. The particular location is chosen because it is essential for the location to have a high amount of transit passing through the space, since the experiment targets mobile behaviour. In addition, the Wageningen University campus is publicly accessible. Although precedent studies have mainly focused on behaviour inside buildings, this research focuses on the outdoors public space, as this is the main object of study within the landscape architecture and planning disciplines. The goal of this intervention is to elicit behaviour cues, which in turn activate behaviour. This study therefore aims to design, install, and evaluate an intervention in public space that can shape movement of individuals. This might be employed as a strategy in future designs (Nikolopoulou et al., 2015). The experiment will be located at the entrance of the Forum building, where users have the option to take either the steps or the slope towards the entrance. Both are located adjacent to each other without physical barriers separating them, and their absolute length towards the entrance is the same. Therefore, there are no rational arguments to favour one over the other. The goals associated with both paths are similar, and decisions about the preferred path are likely to be taken based on nonconscious processes. To ascertain the use of both of the paths, initial observation has taken place. This initial observation indicates that the use of both options is approximately similar. The situation will be studied both with and without the intervention in order to demonstrate the effect of the nudge on the use of the space.

The intervention is a nudge of the prompting type, which elicits environmental cues that affect behaviour. The design of the physical environment can thus play a strategic role in pedestrian behaviour, altering the flow of pedestrian movement on the campus. This experiment is therefore designed to investigate how people respond to nudges in the physical environment. Whereas

physical barriers can be used as a coercive measure to shape crowd flow, nudges are a method of altering behaviour in a more liberal manner. The thousands of primes in the environment that we encounter each day have a significant effect on the way we act (Dolan et al., 2010). According to the concept of nudging, nudging interventions are based on primes, that transform ordinary environmental attributes into environmental cues that are acted upon. It is argued in this experiment that floor markings activate goals that individuals want to pursue, and therefore they will be likely to opt for the marked path. Floor markings are thus chosen as a suitable form of intervention as they can guide moment through space, but yet they do not physically impede pedestrian flow. In design theory, lines are associated with form and direction. In this manner, they control the movement of the body (Hansen, 2013). They can suggest form, even when the line is limited in its extent, and they are understood as a device by which we can understand the relationship between places as they create linkage between places; how to get from “here” to “there”. Thus, they improve the legibility of a place (Ewing et al., 2006). Moreover, radiating diagonal lines, create a feeling of movement, activity, or speed (Hansen, 2013; Motloch, 2001), and are therefore suitable to be used in this experiment. Through design, people have already inherently been primed with the interpretation and function of lines. Previous studies have demonstrated the influence of floor markings on pedestrian route choices, for example in evacuation studies, transport services, and urban planning (e.g. Nikolopoulou et al., 2015; Gibson, 2009).

03.5 INTERVENTION

As stated previously, the chosen nudge is a floor marking. Floor markings intervene in a space by changing the appearance of the ground. They are chosen as a suitable form of intervention, since floor markings can guide movement through space, yet do not physically impede the flow of movement. The floor markings suggest a default direction towards the entrance, and therefore goal priming is employed in order to alter behaviour. As it is not necessary to alter the movement path in order to pass through the intervention at the Forum entrance, changes in behaviour can be attributed to the mere reaction to the presence of the intervention. This reveals how the intervention fits into patterns of everyday behaviour and the behavioural response it elicits (Nikolopoulou et al., 2015). Moreover, people consistently prefer moderate levels of visual complexity and tend to appreciate inherent order in public space. Therefore, these qualities are positively related to preference (Zacharias, 2001). As schema-opposing items or items that are unexpected in the activated schema of users will cause confusion, the new environmental item has to be schema-expected. Therefore, the nudge cannot be too blunt, and thus it will be executed in

neutral colours. In Western countries, yellow and purple are colours that are perceived to have a neutral meaning (Madden et al., 2000). However, in the setting around the Forum entrance, the colour yellow is much more covert since it is already embedded in the colour scheme of the location in other ways. Yellow fits within the analogous colour schema of the campus, and therefore the colour yellow is chosen for the floor markings (Hansen, 2013). Radiating lines that expand outward from a particular point impart energy and convey a dynamic feeling (Motloch, 2001), and therefore the floor markings are placed as a radiating line.

If the available time permits it, the intervention will be varied, for example by changing the type of line, its colour, its location, or other properties of the line. However, this depends on the amount of time it takes to establish a large enough sample size and the willingness of the managers of the location to participate.

Since the intervention does not create physical impossibilities, changes in behaviour can be attributed to the nudging effect of the intervention. The proposed intervention is founded in the nudging theory and has been described and applied previously in this context (HIVOS Seduction Project, 2012), although this conclusion was not drawn as the result of scientific testing. They claim the result of this project was an increase of 75% more people taking the stairs in favour of the elevator. Implementing this idea onto the campus combines the nudging elements of provision of generalised information, to delineate defaults that create a nudge that will stimulate pedestrians to take the marked path. It is related to generalised information in the sense that the floor markings indicate the right direction, providing information for the users of the space. The floor markings are a motivational prompt that stimulate walking behaviour in a certain direction. They elicit an environmental cue, since they are intuitive to follow. Thus, the floor markings can be seen as a default, a pre-set path that indicates how to walk and which behaviour to perform. Defaults are the options that are pre-selected if an individual does not make an active choice (Dolan et al., 2010). Still, there is a possibility to choose other paths, so this intervention does not restrict the freedom of individuals, which is a key principle in nudging theory. Therefore, this investigation implements nudging in an explicitly spatial sense, a venture which has not been performed previously. This is based upon priming theory, since the floor markings indicate the desired behaviour.

03.6 DATA COLLECTION

The research design relates to previous research in the respect that it is founded upon methods applied in earlier studies, as analysed in the literature review. The analysis of these methods leads to

decisions about the approach adopted in this thesis. The empirical research takes a positivistic approach (Hart, 2001) in the form of an experiment. This experiment is founded upon the literature review, and therefore the expectations are based upon deductive reasoning. In this section, the methods, design model, instruments, hypotheses, variables and the sampling strategy are discussed.

03.6.1 METHODS

The method of data collection used in this experiment is structured observation. Structured observation is a method for systematically observing the behaviour of individuals in terms of a schedule, including behaviour categories. It is a technique which employs explicitly formulated rules for the observation and recording of behaviour. The main advantage of structured observation is that it allows behaviour to be observed directly, rather than inferred through surveys or other research methods. Often, there is a gap between stated and actual behaviour, and it can be questioned how well stated behaviour and actual behaviour correspond. The most accurate form of measurement of environmental behaviour is observation of actual behaviour or its immediate outcomes (Steg et al., 2013; Bryman, 2012). The observation method employed in this experiment is covert, non-participant observation, in which the researcher observes a situation but does not participate in what is going on (Bryman, 2012).

03.6.2 OBSERVATION INSTRUMENTS

A crucial step in the structured observation is devising the observation schedule. The considerations are similar to those involved in producing a structured interview schedule. The most important considerations revolve around the focus of the observation, and exactly who and what is to be observed. Moreover, the behaviour categories need to be both mutually exclusive and inclusive. The full observation schedule is presented and explained in appendix B. Therefore, unstructured observation has taken place before the construction of the observation schedule. Also, pilot studies are run, so that possible problems have been anticipated upon in the observation schedule. The resulting schedule described specific behaviour, so that it can be applied to record the behaviour according to predetermined rules. In the observation schedule, categories of behaviour are specified, and it is described how behaviour should be allocated to these categories. The resulting data can be treated as variables (Bryman, 2012).

Other observation instruments include photos and maps of the location, intended for future reference.

03.6.3 INDEPENDENT VARIABLE

In this experiment, the independent variable is the environment. The environment is seen as a dichotomous variable, within which an intervention is either implemented or not implemented. Other independent variables such as gender and group size are recorded, allowing for additional cross-tab evaluation.

03.6.4 DEPENDENT VARIABLE

The dependent variable in this experiment is behaviour. Behaviour is a dichotomous variable in this instance, with individuals opting either for behaviour a or behaviour b. These measures are conducted both in a pre-intervention context as well as a post-intervention context.

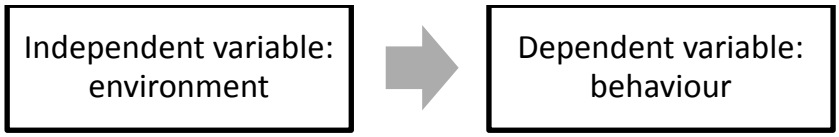

Figure 2: Relationship between variables

03.6.5 SAMPLING STRATEGY

Studies in public areas do not permit perfect random sampling, because it is difficult to construct a sampling frame of individuals passing by (Bryman, 2012). Therefore, an approach of non-probability sampling is employed, due to practical reasons. More specifically, convenience sampling is utilised, indicating that the sample is selected due to its convenient accessibility (Kumar, 2005). The general public are considered to be non-primed participants representing the normal behaviour of individuals on the campus. They are considered to be a proxy of random sampling, if it is assumed that coincidental passers-by are a random sample of the study population. A priori power analysis is performed, conducted before the research study in order to estimate the sufficient sample size and thereby determine how many participants should be observed to achieve the desired level of power. The statistical power of a test is the probability of correctly rejecting the null hypothesis. Increasing the sample size is often an obvious way to increase the statistical power (Field, 2013). The sample size is determined at 306 using an online statistical power calculator (Power $1-\beta = 0.80$, Type I error rate $\alpha = 5\%$, Group 'A' proportion $p_A=0.45$, Group 'B' proportion $p_B=0.55$). The sample size is the same in each experiment.

03.7 DATA ANALYSIS DESIGN

The data analysis is executed in IBM SPSS Statistics 22 as available on the Wageningen University campus. The data consists of dichotomous and categorical variables containing nominal and ordinal values, and therefore they are also recorded as nominal and ordinal data in SPSS. According to good practice, the data is inspected before running the statistical tests. A clustered bar chart is created to visualise the data. This will aid the comparison of the data and makes the large data set more coherent.

All gathered variables are of a dichotomous nature. Therefore, a chi^2 test is used to analyse the gathered data. The Pearson's chi-square test of the independence of two categorical variables tests whether two categorical variables forming a contingency table are associated (Field, 2013). More specifically, it assesses whether the perceived dependence in sample data may be the result of random variability. Therefore, it tests if the differences in the sample data might reasonably have arisen by chance alone (Ott and Longnecker, 2010). Crosstabs are constructed, with the independent variables located on the rows and the dependent variable behaviour located on the columns. The effect size is established using Cramer's V. It is predicted that Cramer's V will indicate at least a minimal relationship (r=.1) (Vaske, 2008). This suggests that 1% ($.1^2$) of the total variance can be accounted for due to the effect of the environment. A relationship of r=.3 indicates a typical relationship, where the effect accounts for 9% ($.3^2$) of the total variance (Vaske, 2008; Field, 2013; Cohen, 1992). Of course, behaviour is established through a multitude of influences, including the physical environment, but also social, cultural, and economic reasons. Therefore, a relationship between r=.1 and r=.3 seems reasonable.

03.8 CONFOUNDING FACTORS

Confounding factors may influence the results of the investigation, since they too can alter the physical environment, thereby affecting decisions made by individuals within this environment. In the research setting, confounding factors include the weather, the day of the week and the time of day, other people making changes in the environment, or special events such as demonstrations, window cleaning or other maintenance activities, or performances. However, there is no way to control any of these variables. Also, their change is gradual, and it is difficult to make distinctions in for example weather conditions or the exact time. Therefore, the confounding factors are

randomised during the experiment, but recorded as variables so their influence might serve as additional data in the analysis.

Furthermore, the salience of the intervention might trigger individuals to consider its presence, which can influence their behaviour. Therefore, a funnelled manipulation check is performed in order to question the participants' awareness of the nudge. This also aids the reflection upon the investigation, and might offer improvements in follow-up experiments.

03.9 POINTS OF ATTENTION

Field studies suffer from a range of limitations. These include difficulties in the replicability of the research, a low internal validity, limits on the ability to obtain informed consent of participants, a large variation in data requiring a larger sample size compared to a laboratory experiment, and less control over extraneous variables that might bias the results of the experiment. However, even if the validity of the one-group pre-test-post-test experimental design is questionable in some instances, it can be warranted in this research. Threats to the internal validity stem from difficulties to document the causal relationship between the intervention and the resulting behaviour. Also, the limited experimental control threatens the internal validity. Limits on the ability to obtain informed consent of participants may jeopardize their privacy, however, the experiment is carried out completely anonymously. Positives are that the research subjects are not aware of the pre-test because it is the currently existing situation, and therefore their exposure does not influence the outcomes of the post-test. Also, the same instrumentation is used for the pre-test as well as the post-test. The requirement for a large data sample means the data collection might be more difficult or take more time, but this is not a large problem in this experiment. Finally, regression effects might occur, diminishing the effects of the intervention over time (Steg et al., 2013).

Furthermore, a threat to the external validity may be selection bias, indicating that the experimental group is not equivalent with the total population. However, large benefits to the external validity are the ability to measure how much of an effect an intervention has on the outcome, and since it is conducted in the real world rather than a lab the experiment takes into account the complex structure of public space. By studying the effects of the environment on behaviour in a real environment, ecological or external validity can be achieved.

Validity of the experiment in its entirety also stems from triangulation with the literature review. The results of this thesis are founded upon two investigations that can substantiate and enhance each other's claims.

04. RESULTS

The results of the intervention have been recorded and processed in SPSS IBM Statistics. They are presented below and discussed in chapter 05. More detailed tables are left out to improve readability, and can be found in appendix C.

04.1 EFFECT OF INTERVENTION ON BEHAVIOUR

The case processing summary indicates that there are no missing variables and that all variables are valid. The data have been inspected and no anomalies occur. However, some observations have been removed, since they might not give a valid representation. These observations are respondents who are in some way unable to opt for one of the paths and they are therefore constrained in their choice by their physical abilities. Due to these physical constraints they had no other choice than to opt for the flat inclining plane because they carried heavy suitcases or they were seated in a wheelchair. Since 7 observations are removed from the original 630 observations, this results in the following case processing summary:

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CONDITION	623	100.0%	0	0.0%	623	100.0%

Table 1: Case processing summary

The frequency table with counts for every observation therefore looks as follows:

		BEHAVIOUR		Total
		Slope	Stairs	
CONDITION	Control	137	175	315
	Intervention	188	123	315
Total		325	298	630

Table 2: Counts of the observations

The inspection of the data reveals that the clustered bar chart indicates that after the intervention has been implemented, the behaviour of users changed. This bar chart displays the occurrence of frequencies and therefore indirectly also the mode of the data. Before the intervention, the mode of the variable PATH_TEST is 1. After the intervention, the mode of the variable PATH_TEST is 0. Less

people opted for path 0 and more people opted for path 1, as can be seen in figure 3. This indicates that indeed, behaviour change has developed in the expected direction.

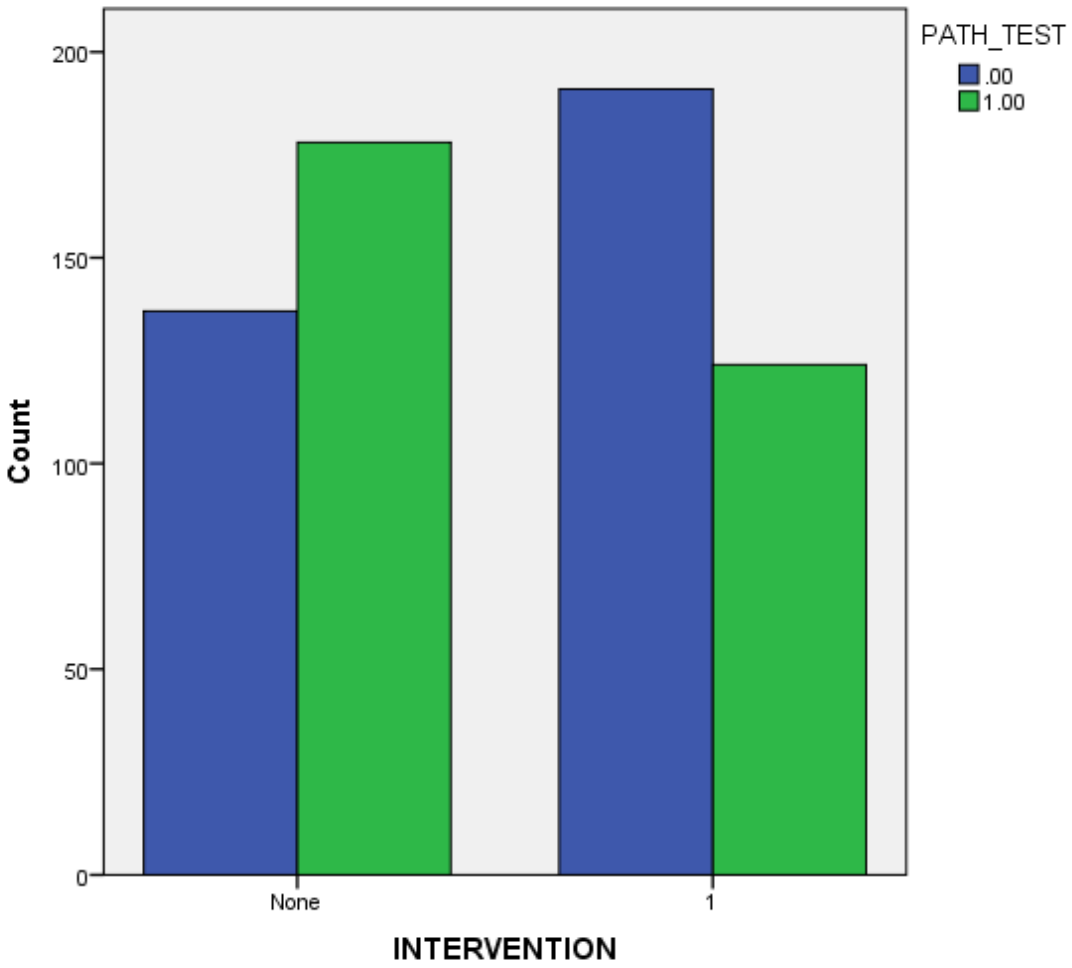

Figure 3: Clustered bar chart of the results

		BEHAVIOUR	
		Slope	Stairs
CONDITION	Control	175 (56%)	137 (44%)
	Intervention	123 (39%)	188 (61%)

Table 3: Crosstabulation testing condition * behaviour

The cross tabulation or contingency table displays the frequency counts of a sample. In the crosstab of this experiment, the frequency data are arranged with the intervention on the rows and behaviour on the columns. The crosstab contains sets of proportions that exhibit independence between the environment and the behaviour performed by its dwellers (Ott and Longnecker, 2010). In the crosstab in table 4 below, these numbers are displayed for the current experiment. It is predicted that the environment variable has some value for predicting the behaviour variable. From the

clustered bar chart and the relating modes, and the crosstabulation, it is indicated that this is indeed the case. There appears to be a degree of dependence between the two variables. The chi-square test assesses whether the perceived dependence is the result of random variability rather than real dependence (Ott and Longnecker, 2010).

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.075	1	.000

Table 4: Chi-square test

This table indicates that there is a significant association between the environment and the resulting path choices $\chi^2(1) = 17.075$, $p < .001$ (Hinton et al., 2004). There is a chance of less than $p < .001$ to find the observed degree of association between the variables if they are perfectly independent in the population. There is a statistically significant association between the row variable INTERVENTION and the column variable PATH_TEST, and thus between the variable 'environment' and the resulting variable 'behaviour'. Since the p-value indicates strong evidence against the null hypothesis, H_0 is rejected. Thus, under the assumption that Ha is true, in this experiment it is demonstrated that the logical complement of the null hypothesis, namely $\pi_i \neq \pi_j$, is true. However, the direction of this alternative hypothesis is not given by the chi-square test. Yet, the clustered bar chart provides insight into this direction. Since the proportion of observations shift towards more people taking the stairs, it can be argued that the *placement of lines* that act as an environmental cue to indicate a default path will lead to *more* people choosing this behaviour and *less* people choosing the alternative behaviour ($\pi_i > \pi_j$).

Cramer's V is a test of the strength of association. Cramer's V is calculated as .166 in this experiment. This result was expected, since an association of at least .1 and at most .3 was predicted. A result on .166 indicates a strength of association somewhere between a minimal and a typical relationship (Vaske, 2008). This results in an effect size of .166, and 2.8% ($.166^2$) explained variance. This means that 2.8% of the variability in behaviour can be explained by the effect of the physical environment in this experiment.

05. DISCUSSION

This chapter aims to discuss the results of the thesis. It examines the results of the thesis' experiment, presents a theoretical discussion about the concept of nudging in the light of the experiment, illustrates different applications, and finally an ethical discussion is elaborated upon.

05.1 EXPERIMENT DISCUSSION

These paragraphs contain a substantive discussion of the results of the experiment. Furthermore, a critical reflection on the methods that have been applied is provided.

05.1.1 RESULTS

Looking thoughtfully at the percentages displayed in the cross tabulation is crucial in deciding whether the results show practical importance (Ott and Longnecker, 2010). Therefore, this chapter intends to elaborate and debate upon the results of the field experiments in order to distinguish this importance in the context of the thesis.

In summary, the experiment has indicated that there is a significant association between the environment and the resulting path choices $\chi^2(1) = 17.075$, $p < .001$ (Hinton et al., 2004). There is a chance of less than $p < .001$ to find the observed degree of association between the variables if they are perfectly independent in the population. There is a statistically significant association between the row variable "intervention" and the column variable "behaviour", and thus between the variable "environment" and the resulting variable "behaviour". Since the p-value indicates strong evidence against the null hypothesis, H_0 is rejected. Thus, under the assumption that Ha is true, in this experiment it is demonstrated that the logical complement of the null hypothesis, is true. However, the direction of this alternative hypothesis is not given by the chi-square test. Yet, the clustered bar chart provides insight into this direction. Since the proportion of observations shift towards more people taking the stairs, it can be argued that the *placement of lines* that act as an environmental cue to indicate a default path will lead to *more* people choosing this behaviour and *less* people choosing the alternative behaviour. This is discussed later in this chapter.

According to the results from the experiment, the nudge is indeed explanative regarding the relationship between the physical environment and behaviour through nudging. Only two people within the sample of 630 stopped specifically to take a look at the lines, which indicates that the reaction was nonconscious. Furthermore, participants who were distracted also seemed to alter their path, which indicates that the resulting behaviour is automatic and doesn't work through conscious

reflection. Statistical results show that the result is significant and therefore it confirms the hypothesis that the placement of lines affects behaviour. Therefore, through goal priming, the line becomes a cue, which in turn influences behaviour by activating mental schema because the line primes specific scripts through the design of the environment. Therefore, the nudge seems to work based on this investigative study.

Cramer's V is calculated as .166 in this experiment. This result was expected, since an association of at least .1 and at most .3 was predicted. A result on .166 indicates a strength of association somewhere between a minimal and a typical relationship (Vaske, 2008). This results in an effect size of .166 and an explained variance of 2.8%. A variance of 2.8% means that 2.8% of the variability in behaviour can be explained by the effect of the physical environment in this experiment.

Also, it has been observed during the field experiment that the influence of other individuals in the research area seems to be of massive importance. They alter behaviour through their presence, exerting social norms and nonverbal communications. Therefore, any concept that aims to represent the total environment has to include the interaction with the social environment as it is of key relevance in explaining behaviour. This is confirmed in the literature (see e.g. Ferguson and Bargh, 2003; Carmona et al., 2010; Mandal, 2014). Individuals are both part of the physical environment and of the social environment, and they can alter and affect both of these environments through their presence.

05.1.2 METHODS

The use of the observation schedule to record observations was a structured method that is both reliable and valid as a measurement instrument. The instrument measures what it is supposed to measure and the results are consistent. Although methodologically, the experiment has been performed in a justifiable manner, critique can also be placed on the experiment. Firstly, the experiment had to be altered due to weather conditions. Although initial plans were to place the lines in another path on the campus, this was impossible due to the rain which washed away the tape. The door at the new location closed at 18.00 and during the weekend, and therefore it was impossible to distribute the samples perfectly across the day. However, little people are present on the campus at these hours, so this might not have had a large effect. Instead, it has been attempted to distribute the samples across the conditions that were available. Furthermore, the research might have been more complete if more observations were made. However, after the initial hypothesis was already confirmed, the time-frame was limited and personal issues restrained further investigation.

Finally, relatively little is known about the long-term effects of the intervention. It is uncertain whether the placement of the lines might change behaviour more or less over time. Currently, investigations have been executed over a time-span of about a week, but it wasn't possible to keep the lines there longer. The effect of nudges over time will be discussed later in this chapter.

05.2 THEORETICAL DISCUSSION

The theory of nudging is discussed in the context of its application in landscape architecture and planning. Thus, its theoretical benefits and pitfalls are highlighted.

As argued previously, behaviour is always context-dependent. Behaviour is determined through an interplay of personal, social, cultural, and economic factors, as well as by the physical environment (Gifford, 2007). Thus, the physical environment is not the only environmental factor that can influence behaviour. Social, cultural, personal, and economic reasons are just as important in determining behaviour (see e.g. Goldstein et al., 2008; Lindenberg and Steg, 2007; Tiemeijer, 2011; Postmes et al., 2009). Therefore, the concept of nudging as presented in this thesis can only explain part of the resulting behaviour. Influencing individual behaviour can be characterised broadly as comprising genetics, individual thoughts and feelings, social interaction, social identity, the macro-social environment, and the physical environment (House of Lords Science and Technology Select Committee (2011). All of these factors can be adapted in order to achieve behaviour change, and often a combination is most likely to create effective measures. Since behaviour is always the result of a combination of environmental, social, and physical factors, nudging is therefore only part of the solution.

Furthermore, the influence of the environment is likely to be less in busy or chaotic environments. Since environmental scripts and relating schema are less obvious, this results in less consistent behaviour. Users don't understand as much of the environment. Additionally, arousal in the environment affects performance. Too much arousal results in a reduction of performance, also indicated as the Yerkes-Dodson law (Yerkes and Dodson, 1908; Cassidy, 1997). Moreover, a clean and well-maintained space suggests that other people care about the environment, thereby setting off cues that change the civic commitment of individuals. This addresses both social norms and the legibility of the environment and alters behaviour (Welsh and Farrington, 2008).

In addition, the interpretation of the nudge is also subject to issues. Scripting indicates that the idea of how to use an object is embedded within the object itself, which has the power to activate the

relating mental schema. Also, semantic variance indicates that the same signal can mean different things for different people and across different contexts. Thereby, objects can obtain multistability, meaning that the intentionality intended by the designer might not be the only possible use, and the interpretation of the object can influence its use by different people. Nudges can thus be interpreted in different manners, not always intended by the designer. This problem increases the need for the landscape to be legible. The legibility of the environment can trigger nonconscious reactions. Therefore, a legible environment that is understandable across different individuals can support the ease of behaviour in the environment since it specifies clearly how individuals are supposed to behave. The atmosphere of an environment also contributes to how individuals behave within it (Rli, 2014). Overall, nudging has the potential to increase the legibility of the environment since it offers environmental cues that support specific behaviour. However, attention needs to be paid to how these nudges can be interpreted across different individuals and contexts.

Also, nudges may suffer from the infantilisation problem (Yeung, 2012). This problem addresses the question whether nudges change preferences, or simply change temporary behaviour. Therefore, it questions how and if nudges will work in the long term. If people become aware of the influence of the nudge, they can also reject it and go their own way regardless. This will be discussed later in throughout this chapter. Still, practice has shown that changing attitudes or intentions does not always lead to behaviour change. On the contrary, structural intrinsic behaviour change is often established by nonconsciously changing habitual behaviour, which in turn becomes the default as it is ingrained into schema. Therefore, the desired attitude is internalised and structural behaviour change can occur. This explains the success of nudging interventions as opposed to classic governmental strategies, as empirical evidence is most likely to be learned. Therefore, these interventions should be stimulated.

Finally, an anti-effect to nudges can also occur. When many people are attracted to a specific nudge, regular users may get annoyed, and change their behaviour in response to the presence of other people. Therefore, the nudge has an effect on sporadic users, but bans regular users and practically forces them to make other decisions. In the long term, this might alter behaviour for the worse.

05.3 APPLICATION AND IMPLEMENTATION

In order to enable the implementation of nudging in a spatial manner, its relevance in policy is compared to the domains within which it may provide helpful interventions. Thus, the potential and possibilities for different applications to be implemented are explored.

As discussed in chapter 04.3, understanding how to change behaviour is a concern for any government policy (House of Lords Science and Technology Select Committee, 2011). Knowledge about this topic can aid the government into creating policy which connects the wants and needs of the government to the perception and implementation from a user's point of view (Tiemeijer et al., 2009; WRR, 2014). Multiple documents elaborate upon implementation guidelines and issues of nudging.

The domains in which choice architecture and nudging can be applied within spatial planning and design can be gathered from the literature and the overview of nudges as presented in appendix A. These themes mainly focus upon applications in healthcare, lifestyle and obesity, traffic safety, security, and sustainability and environmental conservation. These examples, combined with their typology as presented in chapter 05.4, can be used to implement nudging into these spatial domains.

05.4 ETHICAL DISCUSSION

The implementation of nudging is associated with a variety of ethical problems, which will be highlighted in these final paragraphs. The ethical responsibility of different actors is already recognised and highlighted across scientific and policy fields. The topic offers a large potential for controversy, as attempts to change behaviour may be disputed (Dolan et al., 2010). Although Thaler and Sunstein sketch a picture of a utopian society in which nudging benefits the greater good and improves the quality of life in general, it is also argued that nudging will indeed lead society onto a path towards a dysfunctional and dystopic society. Still, the mere fact that this threat is recognised by actors inherently decreases its destructive qualities, since measures can be taken to counteract these problems.

From the perspective of philosophy of science and ethics, different attitudes represent different views upon nudging. From a consequentialist point of view, nudging is acceptable since it creates the greatest good for the greatest number. Consequentialists argue that if the result is permitted, the intention is fine as well. From a deontologist point of view, nudging is also accepted, since the intention of the theory is good. On the other hand, from a virtue-ethicist point of view, nudging is questionable. Nudging might not influence personality traits but merely affect temporary behaviour, and therefore the virtue-ethicist perspective remains unsure.

As argued previously, nudging encounters many problems from an ethical perspective. Interventions to change behaviour can be controversial (Dolan et al., 2010). Nudges can be intrusive, restrict freedom, and lack transparency. Nudges assume that individuals lack the capability to make good decisions for themselves, and therefore it is patronising. This is reinforced by nudges through the

infantilisation problem, indicating that a choice context determines decisions, rather than decision being something internal to the individual. Thus, we do not learn to make good choices, we are nudged to make them, which does not appeal to personal responsibility. Also, changing behaviour in ways that the subject is not aware of is not coherent with a freedom to choose (Selinger and Whyte, 2011). Furthermore, it is difficult to argue that nudges are transparent, since they affect the automatic cognitive system and therefore they are processed nonconsciously. Nudges are considered to be transparent if the nudge can be detected when the individual agent considers them more carefully (Hansen and Jespersen, 2013). Nudging is also distinguished from the illegal form of subliminal messaging because a perceptive person can discern for themselves that an intervention has been implemented (House of Lords Science and Technology Select Committee, 2011). Also, there are debates over what exactly should be optimised. Wants, interests and goals of individuals can have different resulting behaviours. Maybe experts should be preferred in order to choose the ideal option, but they can also be prone to cognitive errors (Schlag, 2010). Thus, nudging is more manipulating than improving, because it is never certain if the nudge is steering people in the direction they want. True preferences do not exist, because choices have been, and will always be, presented in a choice context. Therefore, the libertarian paternalist cannot give people what they want, and can only act as a regular paternalist, giving people what they should want (Leonard, 2008). Choice architects project their own values and preferences of their conceptions of ideal choices onto those who are nudged (Selinger and Whyte, 2011). Consequently, maybe nudges are more like shoves, implementing interventions that do not serve in the best interest of the individual but almost forcing them to follow a specific direction regardless (Schlag, 2010). Finally, the more society becomes habituated to being nudged, the less it is bothered by the incremental introduction of more controlling tactics (Selinger and Whyte, 2011). Therefore, it is important to consider the whole range of possible interventions. Preferences for non-regulatory interventions should not encourage the exclusion of regulatory methods when thinking about behaviour change (House of Lords Science and Technology Select Committee, 2011).

06. CONCLUSION

This thesis intended to investigate how the concept of nudging can be employed as a spatial instrument to steer nonconscious behaviour in public space. The phrase, as coined in *Nudge* by Thaler and Sunstein (2008), describes how non-regulatory interventions influence behaviour in ways that people often do not notice. This concept is explored through literature research, as the scientific evidence was lacking. Furthermore, a field experiment has been performed in order to substantialise the claims that have been made. This research has shown that nudges can be used in order to alter pedestrian movement. Through this research, it has become evident that nudging is grounded in scientific literature, and can also be applied in practice.

This conclusion has implications for the use of nudges in policy and its implementation. A better understanding of the concept of nudging can lead to a more well-designed and pleasant environment, if applied thoughtfully.

Follow-up research will need to demonstrate the application of the concept in a broader range of contexts and locations. Since nudging is a popular phrase for policy-makers, this research is necessary in order to make well-informed decisions on appropriate and well-functioning nudges.

07. REFERENCES

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APPENDIX A: LIST OF NUDGES

Appendix A presents the complete list of nudges that specifically target spatial behaviour, as encountered during the literature review presented in this thesis. The list of nudges serves as the basis for the different types of nudging possibilities that exist for interventions in the environment. These are described in chapter 05.3.4.2.

Int. #	Goal	By	Type	In
1	Saving energy	Comparing energy use to neighbours	Personalised feedback	Scherpenisse et al., 2014
2	Driving cleaner	Personal feedback through gaming	Personalised feedback	Scherpenisse et al., 2014
3	Recycling trash	Green footsteps towards the bin in Copenhagen	Prompting	Scherpenisse et al., 2014; Hansen and Jespersen, 2013
4	Preventing aggressive situations on the street	Dynamically altering the light in response to situations in Stratumseind	Ambience	WODC, 2014
5	Promoting adherence to speed limits	Smileys that show your current speed	Personalised feedback	WODC, 2014
6	Discouraging smoking	Smokers restricted to particular areas	Availability	Peeters and Schuilenburg, 2014
7	Awareness of traffic direction	Painting “look right” on the street in London	Generalised feedback	Hansen and Jespersen, 2013
8	Energy saving	Sticker that reminds you to turn off the light	Generalised feedback	Hansen and Jespersen, 2013
9	Driving with a seat belt on	Seat belt alarms	Personalised feedback	Hansen and Jespersen, 2013
10	Maintaining clean bathroom	Fly-in-the-urinal	Functional design	Thaler and Sunstein, 2008
11	Counteracting deviant behaviour	Posters with faces to increase compliance rates	Prompting	Hansen and Jespersen, 2013
12	Increase awareness during driving	Explicit visual illustrations such		Hansen and Jespersen, 2013

		as fake potholes or fake speedbumps		
13	Improving calm behaviour	Playing relaxing music	Ambience	Hansen and Jespersen, 2013
14	Making healthy choices	Organisation of cafeteria/shop space	Availability and proximity	Thaler and Sunstein, 2008
15	Reduce driving speed	Implicit visual illustrations such as narrowing side-lines in California		Hansen and Jespersen, 2013; Thaler and Sunstein, 2008
16	Promote healthy lifestyle	Stairs within sight, elevators in the back	Proximity	WODC, 2014
17	Waiting for traffic light	Creating a game with the button		Information Resources Management Association, 2015
18	Reducing energy use	Socket that indicates energy use with colour	Functional design/personalised feedback	
19	Healthier eating	Strategic placement of products in the cafetaria		Hanks et al., 2012
20	Reducing energy use	Change default setting on the thermostat	Functional design/default	Brown et al., 2013
21	Reducing paper use	Change default setting on the printer	Functional design/default	
22		Normative messages to protect the environment; social proof indicating % that chooses the right option		Cialdini, 2003
23	Healthier eating	Product placement in the supermarket		
24	Taking the stairs	Placing lines towards the stairs		HIVOS, 2012
25	Product choice	Influence by	Ambience	North, 1997

		playing music		
26	Reduce driving speed	Placing trees along roads		Rli, 2014
27	Altering movement path	Floor markings	Default	Nikolopoulou et al., 2015
28	Encouraging people to take the stairs	Piano stairs		
29	Encouraging people to take the stairs	Place stairs in plain sight, hide the elevators in the back of a building		Thaler and Sunstein, 2008
30	Walking on the right side of the road	Footsteps The Hague Central Station	Default	
31	Encourage people to take the stairs	Mark the steps with information about burned calories	Generalised feedback	
32	Encourage recycling	Wastebins shaped like the products they should contain	Functional design/default	Duffy, 2009
33	Reduce gum littering	Signs with funny questions		
34	Adherence to traffic distinction rules	Choice of cover material		
35	Crime reduction	Mirrors or cameras to make dwellers aware of their visibility	Personalised feedback	
36	Discouraging sleeping outside	Benches that have an angle or armrests to prohibit sleeping		

Table A1: overview of nudges

APPENDIX B: OBSERVATION SCHEDULE

Appendix B elaborates upon the observation schedule that has been employed during the field experiment. It presents an empty observation schedule and explains the different items in it, along with their operationalisation.

Intervention: yes/no
Date: Time:
Weather conditions:

Resp. #	Gender		Group	Distracted		Path choice		Notes
	M	F	#	Yes	No	a	b	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
...								
...								
315								

Table B1: blank observation schedule

Intervention — Yes is checked along with the number of the intervention if the observations are taking place whilst the intervention has been implemented, no is checked if the observations are taking place whilst the intervention has **not** been implemented

Date — Records the date of the observation

Time	Records the time of the observation
Weather conditions	Records the temperature and weather conditions according to the Google weather.com plugin
Resp. #	Records the number of the observed respondent, with recordings starting at respondent 1 and finishing at 315 for each sample (since the sample fulfils the objective when 306 respondents are observed, this allows for the removal of some respondents if necessary
Gender	M records male respondents, F records female respondents
Group #	Records the number of people within the group that the respondent is part of
Distracted	Yes records instances in which the respondent is obviously distracted by e.g. a phone and therefore does not perceive the interventions, no records instances in which the attention of the respondent is not otherwise engaged
Path choice	Column a records instances where the respondent chooses to enter via the inclining plane. If respondents change their path from the plane to the stairs throughout the traverse, this is recorded by adding a number in the b column indicating on which step they chose to continue on the stairs. A cross in column b records instances where respondents take the steps when entering the traverse
Notes	Records special occasions that might necessitate the removal of the respondent later

APPENDIX C: STATISTICS

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
INTERVENTION * PATH	623	100.0%	0	0.0%	623	100.0%

Table C1: Case processing summary

		PATH_TEST		
		0	1	Total
INTERVENTION	None	137	175	315
	Int. # 1	188	123	315
Total		325	298	630

Table C2: Counts of the observations

			PATH								
			Complete	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Incline	Total
INTERVENTION	None	Count	31	7	10	7	11	16	55	175	312
		% within INTERVENTION	9.9%	2.2%	3.2%	2.2%	3.5%	5.1%	17.6%	56.1%	100.0%
		% within PATH	58.5%	41.2%	52.6%	41.2%	78.6%	76.2%	29.9%	58.7%	50.1%
		% of total	5.0%	1.1%	1.6%	1.1%	1.8%	2.6%	8.8%	28.1%	50.1%
	Int. # 1	Count	22	10	9	10	3	5	129	123	311
		% within INTERVENTION	7.1%	3.2%	2.9%	3.2%	1.0%	1.6%	41.5%	39.5%	100.0%
		% within PATH	41.5%	58.8%	47.4%	58.8%	21.4%	23.8%	70.1%	41.3%	49.9%
		% of	3.5%	1.6%	1.4%	1.6%	0.5%	0.8%	20.7	19.7	49.9%

	total							%	%	
Total	Count	53	17	19	17	14	21	184	298	623
	% within INTERVENTION	8.5%	2.7%	3.0%	2.7%	2.2%	3.4%	29.5 %	47.8 %	100.0 %%
	% within PATH	100.0%	100. 0%	100. 0%	100. 0%	100. 0%	100. 0%	100. 0%	100. 0%	100.0 %
	% of total	8.5%	2.7%	3.0%	2.7%	2.2%	3.4%	29.5 %	47.8 %	100.0 %

Table C3: Extended crosstabulation

			PATH		
			0	1	Total
INTERVENTION	None	Count	137	175	312
		% within INTERVENTION	43.9%	56.1%	100.0%
		% within PATH	42.4%	58.7%	50.1%
		% of total	22.0%	28.1%	50.1%
	Int. # 1	Count	188	123	311
		% within INTERVENTION	60.5%	39.5%	100.0%
		% within PATH	57.8%	41.3%	49.9%
		% of total	30.2%	19.7%	49.9%
Total		Count	325	298	623
		% within INTERVENTION	52.5%	47.8%	100.0%
		% within PATH	100.0%	100.0%	100.0%
		% of total	52.2%	47.8%	100.0%

Table C4: Compact crosstabulation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.075	1	.000

Table C5: Chi-square test