

The student as an initiator of the bicycle renaissance in Dublin

A study on the main perceived barriers to daily cycling by the students of
Trinity College Dublin



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Summary

In more and more Western capitals the image of the bicycle is going through a renaissance. It is becoming a 'hip' and sustainable mode of transport among higher educated young professionals. Ireland's capital city, Dublin, aspires to achieve a rise in cycling levels. However, cycling levels still remain low (7% in 2015) and it is uncertain if the target aiming at a 20% share cyclists of all trips in 2020 will be met. Increasing the amount of cyclists in Dublin requires the establishment of a bicycle culture, which will result in the institution of social norms in favour of cyclists and improved safety levels for cyclists. This involves an attitudinal change from a car-centred society towards a more cycle-centred society.

This thesis performs a study on the intention of the students of Trinity College Dublin to use the bicycle for daily commute purposes. The study focuses on the socio-psychological factors related to bicycle use. The aim is to create an insight in the degree to which different attitudes and perceived barriers influence the intention of the students to use the bicycle to commute to the university campus. A survey was distributed among 100 students of Trinity College Dublin. The determinants of cycle intention were subdivided in: perceived convenience, physical determinants and external restrictions. The performed analyses on the obtained data identified the attitudes of the students and the main barriers they perceived when considering to start cycling or to cycle more often. The results indicate that the larger part of the students does not have the intention to use the bicycle to travel to the university campus. Furthermore, the degree to which the bicycle is perceived as convenient (flexible and time-efficient) significantly increased the intention to cycle daily. A negative social image of cycling is considered to be a barrier by a share of the students who never or rarely cycled before. Physical barriers appeared to be the least important for the students and barriers related to safety, infrastructure and the weather showed to be the most important.

These results emphasise the importance of addressing socio-psychological factors related to daily bicycle use, which are often overlooked in transport policy. The improvement of only structural barriers (such as infrastructure) will not necessarily lead to an increase in bicycle use. Since the scope of this study was very small further research would be required to obtain more in-depth knowledge about the prevailing attitudes and perceptions of the student population in Dublin towards cycling. However, this study does offer a starting point from which ideas can be derived for further research on how daily cycling could be promoted more successfully among students who may serve as key players in a possible future bicycle renaissance in Dublin.

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1. Introduction

Increasing awareness of the negative consequences of Climate Change and growing energy shortages are forcing countries to look out for more sustainable policies. A large share of greenhouse gas emissions is produced by the transport sector, including private car use. The bicycle is one of the most energy efficient forms of transport (Gordon, 1991). Also, infrastructure investments in cycling are often very cost-efficient compared to other modes of transport. Cycling has been associated with improvements in public health due to an increase in active lifestyles (Todd, 2009). Policy makers all over the world seem to increasingly recognize the benefits of cycling, shown by a recent rise in cyclists in some of the most profound world capitals, including Paris, New York, London and Munich. In these cities attempts are being made to move away from a car-centred society to obtain higher cycling levels (Parkin, 2012). In his book *Cycling and Sustainability* John Parkin (2012) argues that in many Western countries the bicycle is reliving a 'second golden age'. After a steady decline in cycling levels since the 20th century caused by increased motorization, cycling is receiving a new wave of attention. He argues that:

There is hope here, that the bicycle is being re-fashioned as a potentially global cosmopolitan icon of sustainable urban life ... it is being embraced both by urban youth and by new urban elites, and it is being incorporated into their visions of future cities. (p. 314)

This means that increasing public awareness about the need for a more sustainable lifestyle in combination with an improved image of cycling might cause a reconstitution of the bicycle as an urban and everyday practice in more and more Western cities.

Between 1986 and 2001 Ireland witnessed a sharp decline in cycling levels. The share of people cycling to work, school, or college more than halved in this period from 5.6% to below 2% (Short & Caulfield, 2014). In 2006 the total amount of trips still only accounted for 2% of the total amount of trips. In 2009 Ireland introduced its first National Cycling Policy. Aiming at a more sustainable transport system, this policy set out a goal to achieve a 10% bicycle share of all trips by 2020. In order to reach this target, a 20% bicycle share needs to be achieved in the capital Dublin. In 2013 Dublin City Council informed that in the past decade the number of people cycling into Dublin city had increased by 68.5 per cent. However, coming from a very low share of cyclists the percentage of people travelling into Dublin City by bicycle still only accounted for 7 % in 2015 (NTA, 2015).

Increasing bicycle use in Dublin involves a transition process in which numerous different factors play a role. It demands a change in thinking among all levels of policy makers and a change in attitude amongst the public. Most importantly, it means that a shift in society's mind-set needs to take place away from car-centred ideas. According to Goetzke and Rave (2011) a transition process towards increased use of the bicycle requires the establishment of a 'bicycle culture', which will have the following three effects: the establishment of social norms in favour of cyclists, increased awareness for cycling and improved safety levels through 'strength in numbers'. Borjesson and Eliasson (2012) argue that this will result in the 'choice set effect'. This means that when the number of cyclists increases in a city, more people will, actively or subconsciously, consider the bicycle as an option when deciding how and where to travel. In other words, the bicycle will be included in the traveller's 'choice set', meaning that the bicycle becomes a common, daily mode of transport.

The attitude of students towards cycling can play an important role in the establishment of a bicycle culture in Dublin. In his book Parkin (2012) refers to *the Bobos* of society, also known as the bourgeois bohemians, referring to the 'dominated fraction of the dominant class', he explains: "*This group tends to elevate the need for a simpler lifestyle (in comparison to their more economically powerful peers) into a virtue, and so favour practices of the body, such as cycling more than use of the wallet*" (p. 313). Although Parkin refers this statement to middle-class professionals, it can be argued that many students are middle-class professionals in the making. Also, students are often not yet in the position to afford a car, which could make them more inclined to consider cycling. Furthermore, a possible increased sense of 'young' idealism based on an increased (academic) environmental awareness might motivate students to choose for the bicycle as an embodied performance of green politics (Horton, 2006).

This thesis aims at developing a deeper understanding of the willingness of Dublin's students to use cycling as a daily transport mode. Daily cycling in this research primarily refers to cycling trips from the student's 'home' to the university (also known as commuting) (Nkurunziza et al., 2012). Next to the three main universities: Trinity College Dublin, University College Dublin, and Dublin City University, Dublin counts eight higher education institutes (O' Cearuill, 2013). It was out of the scope of this research to include all higher education institutes; as such the focus of this thesis will be on the students of Trinity College Dublin. This decision was mainly based on the central location of the university.

Following the described aim of this thesis the main research question is as following: *To what degree do students of Trinity College Dublin have an intention to use the bicycle as a daily transport mode and what are the main perceived barriers influencing this decision?* To be able to formulate an answer to this question the following three sub questions are of relevance

in relation to the students of Trinity College Dublin: (1) Do the students have the intention to take up daily cycling or do they already cycle daily? (2) What are the main perceived barriers to daily cycling for the students? (3) What are explanatory background variables of influence on the intention to cycle daily?

Taking up cycling as a daily transport mode implies a behavioural change from one travel habit to another (Nkurunziza et al., 2012; Gatersleben & Applegate, 2007). Based on The Stages of Change model, developed by Proshaska and Diclemente (1984), this thesis sees behavioural change as a process of gradual attitudinal change instead of a singular event. The individual goes through several stages of intention, which determine whether or not an individual takes up cycling as a daily transport mode. By means of this model it can be understood if the students of Trinity College Dublin have an intention to cycle to the university campus, even if they never cycled before. Also, it can be examined which barriers are considered important in different phases of intention and cycling behaviour. In this thesis the determinants of cycle intention are subdivided in: convenience, physical- and external barriers (Heredia et al., 2014). Examining the degree of intention, and the main perceived barriers influencing this intention, could offer insights in the kind of interventions that can be used to successfully push the students into the next stage of behavioural change or to make sure that he or she continues cycling. This means that it can be better understood who cycles and how more people can be persuaded to cycle (more often).

Societal and scientific relevance

The societal relevance of this research can be related to the ambitions of Dublin City Council to develop a more sustainable transport system in Dublin. The council aims at a reduction in CO₂ emissions by promoting and improving public transport- and bicycle use, which is supposed to reduce dependency on private car use for routine trips. Recently the World Health Organisation revealed that at this moment Dublin still breaches safety levels for air pollution (Scott, 2016). Before the start of the economic recession in 2008, which lasted until 2013, Dublin's transport network and urban environment was already under severe pressure as a result of the volume of people working, studying, visiting and living within the inner city. Currently, Dublin's city centre is intensifying again because employment, retail and tourism levels are growing rapidly. It is anticipated that Dublin City Centre will experience a rapid increase in traffic by 2023, of over 20% in the morning peak. Dublin City Council emphasises that: "*As Dublin begins to grow again it is vital that plans are in place to allow the city to avoid the problems which were experienced before, and enable it to develop as a major European Capital City*" (NTA, 2015, p. 4). Often, transport policies focus on the improvement of structural factors related to cycling, such as infrastructure. This approach appears to be insufficient when aiming at a change in

travel behaviour (Moudon et al., 2005; Parkin et al., 2008). Heinen et al. (2011) explain that these policies often fail to tackle underlying constraints (attitudes, perceptions and preferences). A better understanding of the image of cycling amongst students and the barriers they perceive as important to taking up daily cycling in Dublin can create insights in the opinion and demands of students. The obtained insights of this thesis could contribute to the development of more successful policy making and campaigning to promote cycling under students in Dublin.

The scientific relevance of this research can be found in the focus on attitudinal change and perception of barriers related to daily cycling. After performing a literature analysis on the factors influencing cycling, Heinen et al., (2011) and Willis et al. (2013) draw the conclusion that next to cost-benefit analyses, more studies are required that include attitudes and perceptions to create a better understanding of the underlying constraints determining daily bicycle use. The combination of the Stages of Change model (Proshaska and Diclemente, 1984) with the existing literature on barriers to cycling, offers the possibility to understand the decision for daily cycling as a psychological process of attitudinal change on which both personal and environmental barriers to cycling can have an inhibiting influence. The focus on students offers additional insights in the factors that are specifically related to ‘young’ people and cycling as a daily transport mode. As Gatersleben and Appleton (2007) argue in their article, by encouraging more young people to cycle, future generations might perceive cycling as a more common transport mode. Understanding and changing the mind-set of the ‘younger’ generation could play an important role in the establishment of a transport transition in Dublin.

2. Conceptual model and literature review

2.1. Stages of behavioural change

This thesis deals with a process of behavioural change; aiming to find out to what degree the students incorporated the bicycle into their set of daily transport use and to list the main barriers inhibiting this choice. It is argued that having a positive attitude towards cycling does not always mean that a person actually takes up cycling as a daily transport mode. A positive attitude towards cycling is seen as a prerequisite to consider cycling in the first place, but other factors can still inhibit the choice for the bicycle as a daily transport mode. This statement relates to the transactional model of behavioural change, also known as the Stages of Change model (Prochaska and Diclemente, 1984). This model was developed to explain the different stages of behavioural change. It understands change as a process rather than a singular event. Adaptation to a certain behavior is seen as a progression through five distinct successive stages: *pre-contemplation*, *contemplation*, *preparation*, *action* and *maintenance* (figure 1). The model is mainly used in health promotion research, often with a focus on physical activity (Prochaska et al., 1994). However, recently it has also appeared in several transport studies related to cycling behaviour (Nkurunziza et al., 2012; Gatersleben & Appleton, 2005; Bamberg et al., 2011). Being in the *pre-contemplation* stage implies that an individual has no intention to change his or her behaviour; in the *contemplation* stage intention in the form of a positive attitude is present to a certain degree. However, in both stages actual behaviour is not carried out. In the next two stages *prepared for action* and *action* intention is strong and the behaviour has been (ir)regularly performed. In the fifth stage, *maintenance*, permanent behaviour has been established. The *relapse* stage was added for individuals that no longer perform the behaviour or reverted to earlier stages of change (Nkurunziza et al., 2012). Previous studies applying this model to create a better understanding of the intention to cycle found significant differences between the attitudes and perceptions of individuals in different stages of cycling behaviour. For example, Gatersleben and Appleton (2007) found that a negative social image of cycling is an important barrier to individuals in the *pre-contemplation* stage, whereas people in the *prepared for action stage* experienced more personal barriers, such as work and family commitments.

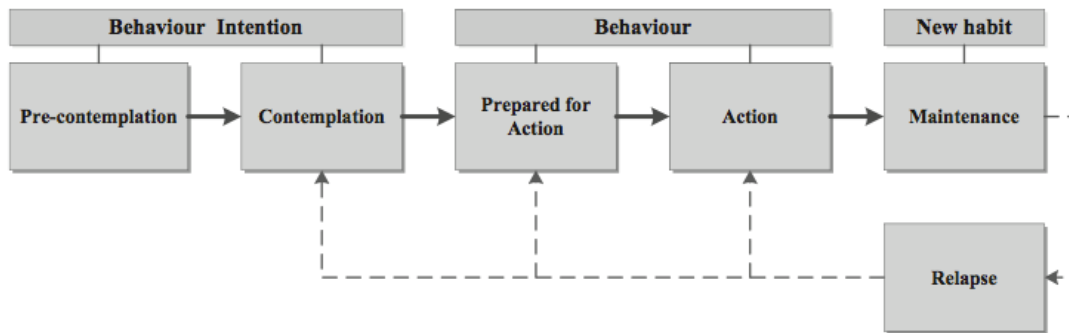


Figure 1: Stages of Change model (Nkurunziza et al, 2011)

For this thesis the model is used to create an insight in the degree to which intention to cycle (positive attitude) exists among the students, which would mean that the students are at least in the 2nd phase of behavioural change: the contemplation phase. Based on the statement of Parkin (2012), arguing that a renaissance of the image of the bicycle is taking place among higher educated young-professionals in Western cities; the first hypothesis can be formulated:

Hypothesis 1: The majority of the students of Trinity College Dublin will have passed the pre-contemplation stage and will be in the contemplation stage or in higher stages of cycling behaviour.

2.2 Factors determining bicycle use

Many different studies have examined the factors determining bicycle use. Many of those studies emphasize the importance of psychological and social factors influencing the decision of an individual to cycle (Gatersleben and Appleton, 2007; Heinen et al., 2009; Nkurunziza et al., 2012; Parkin et al., 2008).

In the literature different types of classifications of the psycho-sociological factors influencing bicycle use can be found (Heinen et al., 2010; Rietveld and Daniel, 2004; Willis et al., 2013). In this thesis the classification of the factors influencing the intention to cycle are based on the model developed by Heredia et al. (2014), who argue that cycling intention is influenced by three factors: perceived convenience, physical determinants and external restrictions. This categorization helps to develop a better understanding of the nature of the different perceived barriers. For example, someone might perceive the bicycle as a very convenient and sustainable transport mode. However, he or she might still be restrained to actually take up cycling because of perceived unsafety caused by the motorized traffic. The barriers specifically related to the three determinants of intention will be set forth in this chapter.

The relationships between the perceived barriers (independent variables) and the intention to cycle (dependent variable) form the basis of this study on which the hypotheses will be based. Even though the perceived barriers are categorized under the three determinants of intention it is important to remember that the perceived barriers are often interrelated. At the end of this chapter the other explanatory background variables are discussed. These factors are not the direct research objective of this study, however they cannot be neglected, as they are important to consider when interpreting the results.

2.2.1. Convenience: Time, speed & practicality

The ‘convenience’ variable is based on convictions that cycling offers ‘flexibility’ and ‘efficiency’ (Heredia et al., 2014). In other studies these convictions are often placed next to other factors that create a general positive attitude towards cycling. These other factors include the more general beliefs about the bicycle being an economical, healthy, fun and environmentally sustainable transport mode (Gatersleben & Appleton, 2007; Heinen et al., 2011; Paige et al., 2013). However, in their article Heredia et al. (2014) found that the latter factors should be perceived as ‘pro-bike factors’ that indirectly influence the intention to cycle through the convenience variable. This finding is based on the claim that direct benefits (flexibility and efficiency) related to bicycle use are often the most important for an individual. Heinen et al. (2011) also found that the decision to cycle is mainly based on direct benefits in time, comfort and flexibility. Handy and Heinen (2012) found that even if people acknowledge the environmental and health benefits of cycling, it does not necessarily mean that they are cycling. Meaning that perception of these more ‘indirect’ benefits alone is often not enough to change their behaviour.

Perceived distance has an important influence on the degree to which an individual thinks of the bicycle as a convenient transport mode. Research shows that there is a general decrease in cycling uptake with increased distance of trip (Pucher & Buehler, 2006). The perceived distance differs per individual, possibly also relating to the level of cycling experience. Gatersleben and Appleton (2007) found that people who never considered cycling before often mentioned distance as a detrimental barrier. However, in many cases their actual distance was similar to, or even less, than people that did have a positive attitude towards cycling.

Several other studies show that a positive attitude towards cycling reduces the importance of distance as a barrier to daily cycling. For example, Handy et al. (2010) found a positive correlation between the levels of enjoyment of cycling and the distance cycled. Non-cyclists might also perceive trips to be longer because they are less aware of the quickest routes

(Hendriksen & Engbers, 2010). Tranter (2012) mentions that drivers often underestimate the travel times of their journeys. If a commuter experiences that traffic jams can be avoided when cycling his or her perceived distance related to bicycle use might decrease. The perception of distance can also be negatively influenced by poor quality of infrastructure when time-efficiency is not optimal. Heinen et al. (2011) emphasize that for trips less than 2 km, the bicycle is often perceived as a less attractive transport mode because people choose to walk these shorter distances.

Other barriers influencing perceived convenience are related to the practical use of the bicycle. Sometimes people perceive it as a barrier that they feel a need to change their clothes after cycling, or that it is unpractical to use the bicycle when they need to carry things with them from one location to another (Paige et al., 2013). Subsequently, two hypotheses can be formulated on the basis of these findings:

H2: Increased perceptions of convenience benefits are associated with a stronger intention to cycle daily.

H3: The stronger the intention to cycle the less perceived distance will be considered as a barrier to daily cycling.

2.2.2. Physical barriers to daily cycling

Physical barriers relate to the personal evaluation of confidence in physical condition and confidence in cycling skills. The physical barriers are considered to be important as it is argued that even if an individual is convinced that a certain behavior will have positively valued outcomes, he or she will only be motivated to actually perform the behavior when he or she is confident about his or her capabilities to successfully perform the behavior (Wallston, 1992). However, concerning the three determinants Heredia et al. (2014) found that physical barriers had the lowest influence on the intention to cycle daily. Especially for 'young' people the physical barriers appear to be less important, because the physical condition is often in a good state.

The orography of the landscape can increase the perception of physical barriers. Several studies show that the presence of slopes decreases the likelihood of bicycle use. Rietveld and Daniel (2004) found that while leisure cyclists might prefer a hilly terrain, commuting cyclists often perceive it as a barrier. Dublin's landscape can be considered as mainly flat but also has some hilly parts, which possibly requires a somewhat higher physical fitness of the cyclist. The influence of this factor will, therefore, also depend on the area

where the individual lives, as landscape characteristics will differ per route. These findings lead to the following hypothesis on the relationship between physical barriers and the intention to cycle:

H4: Higher uncertainty in cycling competence is associated with a lower intention to cycle daily.

2.2.3. External barriers to daily cycling

Compared to the physical barriers, the external barriers are considered to be the factors that are not under the users' control. The following factors are distinguished: social image, safety, infrastructure, bike-theft and the weather.

Social image:

The prevailing image of cycling could be seen as a barrier to daily cycling. This would mean that the individual feels that his or her social status will be negatively affected when taking up cycling for commuting purposes. This barrier may be of influence if the image of cycling as a 'hip' and 'sustainable' transport mode has not yet been established in Dublin or if people do not feel connected to that kind of image. As this thesis mainly relates to 'young' people, social status might be an important factor. For example, in their study Nkurunziza et al. (2012) found that many university students had a positive attitude towards cycling but that they perceived a feeling of shame to actually take up cycling. The perceived social status is often based on normative beliefs. These are the beliefs an individual holds based on the opinion of a particular referent. The difference between normative beliefs and social norms is that the normative beliefs involve specific individuals or groups to which a person refers to rather than a generalized social agent. When forming the perceived norm, the individual takes normative prescriptions of various individuals and groups into account because not every possible referent will be of relevance for a given behavior. For example, whether friends cycle or not might be of influence on the decision of the individual to take up cycling (Fishbein & Ajzen, 2011). Gatersleben and Appleton (2007) emphasize that more needs to be done to improve the image of cycling, as they found that people who never contemplated cycling believed that they would feel strange on a bicycle and that others would also see them as strange if they would cycle. The establishment of a bicycle culture requires a shift in the image of cycling from solely a leisure activity for which you need special clothing, towards a regular daily transport mode (Parkin, 2012). The hypothesis that can be formulated about the relationship between 'the image of cycling' and the intention to cycle daily, is as following:

H5: The more negative the perceived social image of cycling the lower the intention to cycle daily.

Safety

The perception of safety has shown to be an important barrier to cycling (Heredia et al., 2014; Short and Caulfield, 2014). The personal perception of safety often has a greater influence on the decision to cycle than the actual measured safety. In certain environments cycling can be measured as unsafe based on objective factors such as traffic speed and accident rates (Handy et al., 2010). In their study Short & Caulfield (2014) reported that although cycling fatalities reduced in Dublin, the risk per kilometre to be involved in a fatal collision is still 8 times higher for cyclists than occupants of other vehicles. The perception of safety however is not always correlated with the actual measured risk. It was found that the perceived risk of unsafety is often higher among people with less cycling experience (Rietveld & Daniel, 2004; Lawson et al. 2013).

Perceived personal security could also serve as a barrier to cycling. This factor relates to the anxiety an individual might experience about one's individual safety when going out on a certain time of the day or in a certain sector of town (Rietveld & Daniel, 2004). The degree to which a bicycle friendly atmosphere has been put in place can also have a negative influence on perceived safety. This mainly relates to car-centred attitudes of drivers, which could cause a feeling of social insecurity (Nkurunziza et al., 2012). In car centred societies people often do not choose to drive a car. It is seen as a logical choice because they live, and participate in a society in which the car dominates the system of movement. In car centred societies 'ordinary cycling' is often marginalized. Traffic infrastructure and rules are often in favour of cars and drivers are forced less to be aware of and give priority to the more vulnerable cyclist. As regards to the relationship between perceived unsafety and the intention to cycle, the hypothesis is based on the finding that perceived unsafety is often higher among people with less cycling experience:

H6: A lower perception of unsafety is associated with a higher intention of daily cycling.

Infrastructure

Inadequate quality of cycling infrastructure can serve as an important barrier to daily cycling. It may involve poor road surfaces or the absence of an interconnected cycling network. The latter might force the cyclist to make many detours. Stinson & Bhat (2005) note that commuting cyclists will prefer a route with continuous cycling facilities and that they will be discouraged to cycle when such a route is not available. They also found that travel time is the most important factor influencing route choice. This means that the installation of a functional bicycle network, which improves the directness of cycling routes, is very important. Furthermore, poor quality of infrastructure can also have a negative influence on physical comfort and (the perception of) safety (Rietveld & Daniel, 2004; Short & Caulfield, 2014). An increase in cycle paths has shown to result in a rise cycling levels. People often mention that they would be more tempted to cycle if there were more cycling paths and if they were connected better and easier to reach. The following hypothesis can be formulated:

H7: The more observed infrastructural barriers the lower the intention to cycle daily.

Bike theft:

Few studies have been performed on the relation between the availability of safe and convenient bicycle parking (secure from theft) and its effect on a possible rise in cycling levels. However, studies that did examine this relationship show that it can be an important determinant of bicycle use (Handy et al., 2010; Pucher et al., 2010). Furthermore, Gamman et al. (2004) stress that 'simple' bicycle planning will not be sufficient. Secured bicycle parking should be provided, along with police surveillance in some cases. They argue that the installation of bicycle parking needs careful contemplation taking the environmental context into account before it could be considered 'secure' and 'convenient'. For example, making sure that the parking facility is not too far located from the arriving destination of the cyclist.

The price of the bicycle could also count as a barrier to daily cycling (Paige et al., 2013). This relates to the fear of bicycle theft or the perceived social image of cycling. If a person thinks cycling for commuting purposes requires wearing special (professional) sports clothing, this person might also think that he or she should buy an expensive and advanced bike. The results of an online survey conducted in 2014 among 1.500 people by the Dublin Cycling Campaign showed that one in six people who experienced bike theft did not return to cycling. It is estimated that more than 20.000 bicycles are stolen in Dublin per year (Dublin Cycling Campaign, 2015). The following hypothesis can be formulated:

H8: A stronger perception of the risk of bike-theft has a negative influence on the intention to cycle daily.

Weather:

Actual precipitation, or the idea that there is a chance of rain, is often mentioned as an important barrier to daily cycling (Heinen et al., 2010). However, in cycling capitals Amsterdam and Copenhagen cycling levels remain steady throughout the year, even though these cities have similar rainfall levels as Dublin (Caulfield, 2014). Thus, it seems that this barrier is not crucial and can be mediated by other factors such as good cycling infrastructure. The following hypothesis can be formulated:

H10: Perceived 'bad weather' conditions are associated with a lower intention of daily cycling.

2.2.4 Explanatory background variables

Studies report ambiguous findings on the relationship between cycling and factors such as age, gender or level of income. Regarding age, several studies find that cycling levels decline with age (Moudon et al, 2005; Pucher et al., 1999; Zacharias. 2005). Decreased physical fitness is mentioned as a cause (Heinen et al., 2010). However, others find that age is not a significant factor (Heredia et al., 2014; Wardman et al., 2007).

In regards to income, one might expect that cycling levels decline with a higher income, when increased purchasing power leads to the ability to afford more expensive 'higher status' transport modes, such as a car. This assumption is confirmed by several studies (Schwanen and Mokhtarian, 2005; Witlox and Tindemans, 2004). However, Pucher et al. (1999) and Stinson and Bhat (2005) find a correlation between higher income levels and increased cycling. Pucher and Buehler (2008) explain that wealthy people may pay more attention to a healthy lifestyle. Some studies specifically find a negative relationship between car ownership and cycling (Pucher & Buehler, 2006; Parkin, 2012). Stinson and Bhat (2004) state that owning fewer cars will lead to increased cycling. Not surprisingly, bicycle ownership is also an important determinant for cycling (Heinen et al, 2010).

Regarding gender, most studies find that men cycle more than women mostly based on differences in perceptions of risk and safety (Garrard et al., 2008; Rietveld & Daniel, 2004;

Pucher et al., 1999). Garrard et al. (2008) found that women substantially cycle less than men in cities with low cycle levels because of safety concerns (Byrnes et al., 1999).

Ambiguous findings on all three determinants (age, income and gender) can partly be explained by differences in cycling levels and cycling cultures between countries. Pucher & Buehler (2008) note that in countries where cycling is not yet internalized as a common transport mode, cycling levels are most common under young men, while women cycle far less. However, in countries where cycling has become a mainstream form of transport, such as in The Netherlands and Denmark, cycling levels are almost equal amongst men and women and cycling levels only fall slightly with age.

Since cycling levels are still low in Dublin, it is expected that differences in socio-demographic characteristics still have a differentiating effect on cycling uptake in this city. However, as this thesis focuses only on the cycling intentions of students studying at Trinity College Dublin, a selection can be made in the background variables that are most likely to influence the intention of this specific societal group. First of all, age is not expected to have a significant impact on the physical condition and the cycling intention, as the average age in this group is relatively young. Car access might increase with age, as more and more students will acquire their driving license. Because the students do not have a full-time job yet, their personal income is expected to be relatively low. However, the socio-economic background of the larger part of the students at Trinity College Dublin is relatively wealthy, with most students having one or both parents working as 'employer and manager' or 'higher professional' (Equality Office and Monitoring Advisory Group, 2015). This could possibly increase the change of car ownership or car access amongst these students. It could also provide for a more negative social image of cycling amongst the students when the social environment of these students evaluates cycling as something that only 'poorer' people do. Furthermore, Trinity College Dublin has a relatively large share of international students (15%). Differences in ethnical and cultural background might also have an influence on the intention to cycle daily (Rietveld & Daniel, 2004).

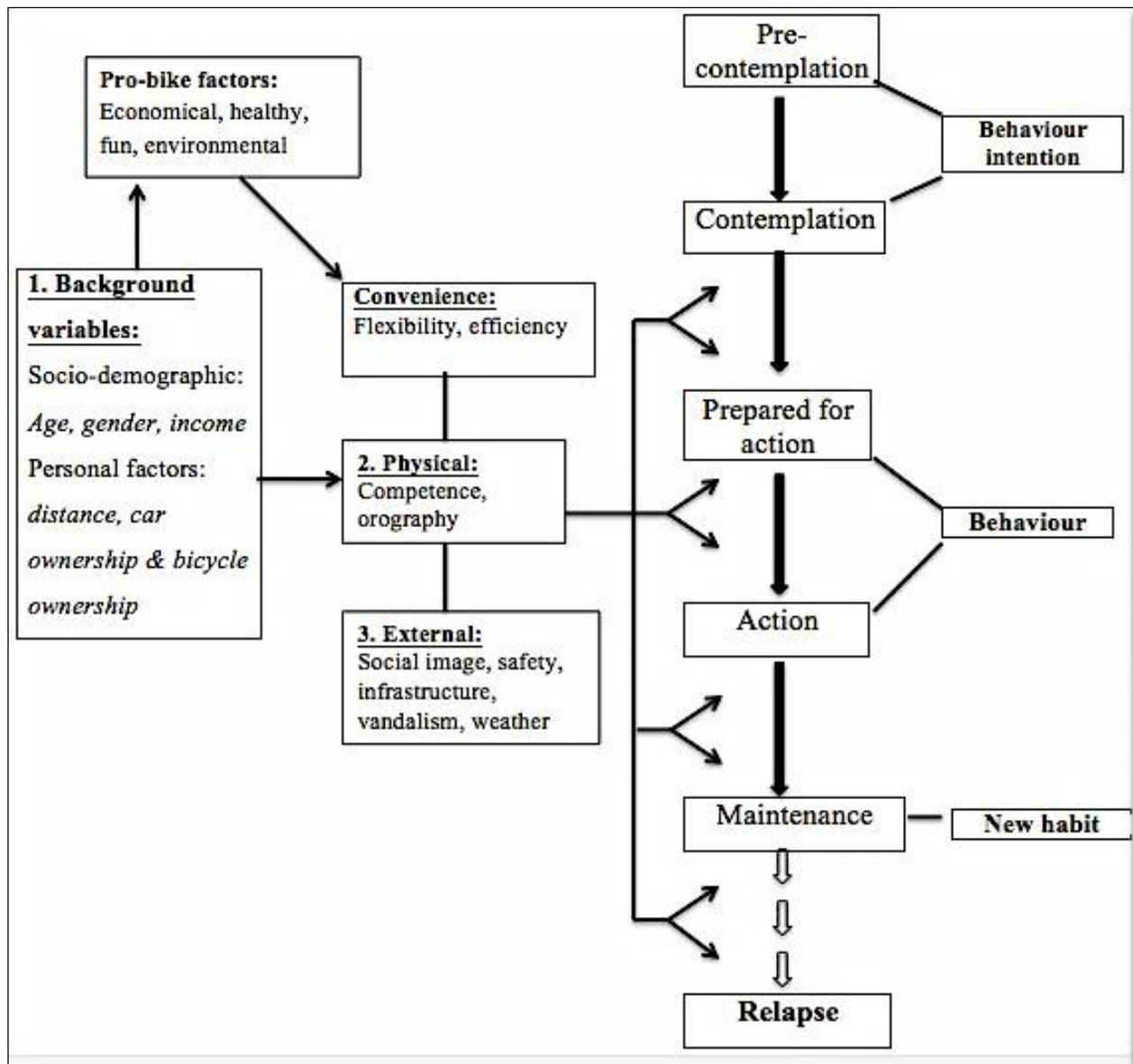
2.4 Conceptual model

In this section the theoretical findings described in the previous chapters will be combined into a conceptual model, which will lay the foundation for the research method applied in this thesis (figure 2). The Stages of Change model is used as a tool to be able to classify the different perceptions of barriers to cycling per stage of behavioural change. By understanding the uptake of daily cycling as a process of increased intention and behavioural change instead of a singular event, a process analysis can be performed. In this way it can be better understood if certain interventions will be more successful with individuals in one stage and less with individuals in another stage of behaviour (Nkurunziza et al., 2012).

Fig. 2. Conceptual model: Determinants of Intention combined with Stages of Behavioural Change

Factors influencing cycling intention

Stages of Change Model



3. Method

In this chapter the described theoretical elements related to the intention of daily bicycle use will be operationalized in order to find an answer to the main question of this study, which is as following: *To what degree do the students of Trinity College Dublin have an intention to cycle daily and what are the main perceived barriers influencing this decision?* The research goal is to find out if students in earlier stages of cycling behaviour perceive different barriers (as regards to convenience, physical determinants and external restrictions) than students in later stages of cycling behaviour. The sequence in this methodological chapter is as following: First, the data collection and the procedure of the survey will be described. Secondly, the measurement scales of the different variables are put forward. Finally, the statistic analyses that were used to test the hypotheses are explained.

3.1. Data collection

A survey was conducted among 100 students of Trinity College Dublin. Most recent data show that the total number of undergraduates was 12.355 in 2014. In the same year the number of postgraduates amounted to 4.309 (Equality Office and Monitoring Advisory Group, 2015). Because of the small scope of this thesis it was not possible to make use of a-select sampling, which would require carrying out a survey among 373 respondents. Instead systematic sampling was used to achieve an accurate representation of the population. Every other 3rd person was approached until the target of 100 respondents was reached. The survey was distributed on different days and different locations of the university's campus. Because the surveys were carried out at the end of the semester the official teaching period was already coming to its end. However, the amount of students still present on the campus for purposes such as exams, dissertations or other activities was sufficient. Several locations on the campus such as the library, the gym, outdoor sports fields and the campus bar were still crowded. For this reason the four main locations of survey distribution were: the entrance of the university campus, the entrance of the library, the gym and the campus bar.

The decision to carry out surveys was made deliberately because it offers the possibility to collect information about the main factors of influence on the student's attitude towards cycling and the decision to cycle or not. Next to this, the goal of this study is to create an insight into the degree to which (and how) different factors influence the decision to cycle in different stages of cycling uptake. This will be measured by asking the students to rate the importance of certain barriers possibly influencing his or her decision to not cycle or less than intended. In contrast to qualitative research, the surveys offered the possibility to make (cautious) statements about the larger population of Trinity College's students.

Eventually the target of 100 respondents was achieved. Obtained data on all questions are nearly complete. However, answering all questions was not compulsory, which resulted in a few missing values. The ages in the sample range from 18 to 34 years old. Other collected background data concerned gender, age, study level and nationality. In table 1 the distribution of the sample compared to the total population of Trinity College Dublin can be found. The data about the population was retrieved from the Annual Equality Monitoring Report released by the university in 2015 (Trinity College Dublin, 2015). The percentages of the sample are not displayed, as the total amount of respondents is already 100.

To test if the obtained sample is a representative reproduction of the population a Chi-square goodness-of-fit had to be carried out. This test offers the possibility to calculate whether or not the categorical variables correspond to the data of the population (Baarda et al., 2012, p. 277). The degrees of freedom are important in this calculation ($n-1$) where n is the number of categories in the variable. The calculation for gender shows a critical value of 3.84 ($df=1$ en $\alpha=.05$) with a X^2 -value of: 2.63. This value does not exceed the critical value. Hence, the result is not significant which means that the gender balance in the sample is a representative reproduction of the population. The critical value for age is 12.59 (6, $\alpha=.05$) and the calculated X^2 is 28.1. This means that the age distribution of the sample is not representative for the population. Study level ($X^2=36.8$) and nationality ($X^2=30.49$) do not prove to be representative either (2, $\alpha=.05$). These results were to be expected because of the dates on which the survey was distributed. As described above, many undergraduates already finished their exams, resulting in a higher number of postgraduates. This also altered the average age of the sample. Based on literature findings the variables 'age' and 'study level' (unrepresentative) are not expected to be as important as the variable 'gender' (representative). As described in the theoretical framework 'age' only seems to impact cycling behaviour when dispersion is very wide (e.g. 8 to 80 years old). However, a higher average age might lead to a higher number of respondents having a driving license and car access. The number of (visiting) international students is also overrepresented in the sample. This needs to be taken into account when interpreting the results.

Table 1. Descriptive statistics of the categorical variables (N=100).

	Sample (N=100)	Population	Percentage
Gender			
Male	50	9636	42
Female	50	7093	58
Total	100	16,729	100
Age			
20 and under	30	5.774	42
21	12	2.267	16
22	14	1,721	12
23	10	833	6
24	6	501	4
25-29	23	1,437	10
30 and over	4	1,318	9
Missing	1	-	-
Total	99	16729	100
Study level			
Undergraduate	55	12.355	73,5
Postgraduate	39	4.309	25,5
Visiting (other)	6	65	1
Total	100	16729	100
Nationality			
Irish (N.I. included)	73	14220	85
Other EU-countries	17	836	5
Non-EU	10	1673	10
Total	100	16729	100

3.2 Operationalization

In this chapter the used research tools are explained. These instruments were chosen so that the different concepts and relations put forward in the conceptual model could be measured as accurate as possible. Because this study tries to capture the personal perception of the student, a list of statements was prepared on which the selectable answers were ranged on a five point Likert-scale. To minimize the occurrence of social-desirable answers, the statements were put forward as neutral as possible. The final survey can be found in appendix 3.

3.2.1 Intention to cycle to the university campus

The dependent variable – the intention of the students to cycle daily – was measured by the six stages of the Stages of Change model. The original model developed in 1984 by Prochaska and Diclemente was not designed to measure cycling intention. In 2011 Nkurunziza et al. developed a measure scale derived from the same model but focused specifically on cycling. They asked their respondents to choose from the following six statements: *‘I never really think about and don’t even consider cycling to my daily activity’*. *‘I never used a bicycle but sometimes think*

about cycling to my daily activity'. *I rarely use(d) a bicycle but I seriously consider cycling to my daily activity*'. *I cycle fairly often to my daily activity*'. *I cycle always to my daily activity*'. *I used to cycle to my daily activity but not anymore*'. The same statements were used in the prepared survey for this thesis. Because this study focuses on the students of Trinity College Dublin and their daily commute, which mainly comprises travelling to the university campus, 'cycling as a daily activity' was replaced with 'cycling to the university campus'.

Furthermore, the research sample for this thesis is very small. A possible lack of respondents per category of intention will make it impossible to draw conclusions about the found relations and the explained variance. For this reason, the initial six statements were reduced to five, to prevent the data from overlapping. After critical analysis the statements: 'I never use(d) a bicycle but sometimes think about cycling to university and I rarely use(d) a bicycle but I seriously consider cycling to university' were combined into one category, based on the argument that 'never used' and 'rare use' of the bicycle are the closest related statements.

3.2.2 Determinants of intention

A list with statements was compiled, in order to measure the degree to which the students (1) consider the bicycle as a convenient daily transport mode and the extent to which they perceive (2) personal and (3) external barriers related to daily cycling. The listed factors and reasons on the questionnaire were derived from earlier studies that performed similar quantitative research on the perceived barriers to daily cycling (Akar and Clifton, 2009; Gatersleben & Appleton, 2007; Handy et al, 2010; Heredia et al, 2014, Nkurunziza et al., 2011).

The attitudes related to perceived convenience of the bicycle were measured by statements on the flexibility and efficiency of cycling, found in Handy et al, (2010), Akar and Clifton (2008) and Heredia et al. (2014). To measure these attitudes a Likert scale was used (1=strongly disagree, 5=strongly agree). From the earlier described pro-bike factors (environmentally friendly, healthy, cheap and fun) that were found to indirectly influence intention through perceived convenience, only the 'fun-aspect' of cycling was included in the questionnaire. Examining the other pro-bike factors was out of the scope of this study, as this would require a larger study in which other related attitudes such as the level of environmental awareness are included as well. Furthermore, several perceived barriers related to the social image of cycling were also measured on an attitudinal scale, because placing them under the subsequently asked 'perceived personal barriers' was not appropriate. An example is: *'Cyclists are athletic, professional, require special equipment'*.

Next to the attitudes, the perceived barriers were also measured on a Likert scale. However, this scale ranged from '1=not important at all' to '5=very important'. The respondent

was asked to rate the degree to which the listed reasons/factors had an impact on his or her decision to not cycle or that could lead to less use of the bicycle than intended. The question was phrased in this manner so that all respondents, no matter the stage of cycling behaviour, would be provoked to apply a ranking to the given barriers, even if they never cycled before.

3.2.3 Explanatory background variables

The socio-demographic characteristics and personal factors concerning gender, distance, car access and bicycle ownership were included to demonstrate the influence of contextual factors on the found relations between the perceived barriers and the intention to cycle daily.

An attempt was made to measure the ‘actual’ distance. This background variable could be helpful when trying to indicate whether or not the personal perceived distance differs between respondents in different stages of cycling behaviour. The following question was asked: ‘What is the approximate distance from your home to the university campus?’ Based on the findings by Heinen et al. (2010) the respondent could choose between 5 relevant distance categories: ‘Less than 2km’, ‘2-4km’, ‘5-7km’, ‘8-10km’, ‘More than 10km’. Car access among the students was also examined and besides answering ‘yes’ or ‘no’ the respondent could answer ‘I don’t have a driving license’. This option was added because the minimum age for driving is 17 years old in Ireland (Citizens Information Board, 2016). Also, it is anticipated that not all students will have the money, time or desire to get their driving license immediately after turning 17.

3.3. Data analysis

In this section the performed statistical tests to analyse the obtained data are explained. Statistical tests are carried out in order to find out whether or not the explanatory variables (explained above) have a significant effect on the dependent variable (the intention to cycle). First the explanatory background factors are measured per stage of cycling behaviour and the Chi-square test was used to test whether or not there is a significant difference between the different stages of behaviour. Chi-square tests could also be used to examine the relationship between the perceived attitudes/barriers and stages of cycling behaviour. However, in order to be able to find out more in detail about the meaning of this relationship and if the independent variables and explanatory background factors mutually influence each other, the Pearson’s Correlation test offers more insight.

The independent variables in this study are considered to be of ordinal level because the variables were measured on a five point Likert-scale, which creates a rank in order by which the data can be sorted. The dependent variable (the intention to cycle) is considered to be of ordinal scale as well, because it ranks the different degrees of intention per stage of cycling behaviour.

Since this analysis concerns a relationship between two categorical variables, a Pearson Correlation test can be carried out, which evaluates how likely it is that an observed discrepancy between sets (stages of cycling behaviour) arose by chance. This test offers the possibility to examine if the perceived independent variables differ significantly between the different stages of cycling behaviour. In simpler words: if a significant difference can be found in perceived convenience and/or physical and/or external barriers per stage of cycling behaviour. These results form the basis for a possible verification of the established hypotheses. If a certain attitude or perceived barrier appears to have a significant different value for the different stages of cycling behaviour, the null-hypothesis can be rejected (with caution) on the basis of this sample. The background variables were also included as control variables, which could offer valuable explanations about the effect of contextual factors on the found relationship between the independent and the dependent variable.

4. Results

In this chapter the obtained results from the conducted survey will be analysed. First of all, the descriptive statistics of the explanatory background variables will be set forth to create a general picture of the distribution in numbers of students per stage of cycling behaviour. The results of the Chi-square tests on this data will indicate if these background factors differ significantly per stage of behaviour. Subsequently, the results of the Pearson's Correlation test are listed by which the (significant) correlations and the effect of these correlations can be interpreted. The interpretation of the correlation coefficient (r) is as following: When r is close to one it means that there is a strong relationship between the variables (close to 0 means a weak relationship). Furthermore, the relationship can be negative or positive: When r is positive it means that an increase in one variable will also mean an increase in the value of the other. Negative correlation means that if one variable increases, the other variable decreases. In the table the 'Sig (2-tailed) value' is given. This value shows if a correlation is statistically significant (* $p < .05$ ** $p < .01$). The outcomes of these tests will determine whether or not the hypotheses can be verified on the basis of this sample.

4.1 Descriptive statistics and correlations

In general, the intention to cycle daily among the sample respondents appears to be low. Of the 100 respondents, 40 respondents stated that they never really considered cycling to the university and that they have no intention to do so (pre-contemplation stage). Another 24 students never or rarely cycled to the university campus. Only 15 students turned out to have a daily cycling habit.

4.1.1. Explanatory background variables and the stages of cycling behaviour

In table 2 on the following page the distribution of the explanatory background variables per stage of cycling intention can be found.

Table 2. Socio-demographic information of the sample per stage of cycling behaviour (n=10)

	PC (n=40)	C (n=24)	A (n=13)	M (n=15)	RE (n=8)	Overall (n=100)
Gender						
% Female	45.0	70.8	30.8	53.3	37.5	50.0
Age in years						
% 18-20	25.0	45.8	38.5	26.7	0.0	30.0
% 21-24	45.0	33.3	23.1	53.3	62.5	42.0
% > 24	30.0	20.8	30.8	20.0	37.5	27.0
Distance to the university						
% < 2 km	12.5	12.5	0.0	6.7	25.0	11.0
% 2-4 km	40.0	33.3	53.8	46.7	12.5	39.0
% 5-7 km	17.5	29.2	15.4	26.7	37.5	23.0
% 8-10 km	15.0	20.8	0.0	20.0	0.0	14.0
% > 10 km	25.0	4.2	30.8	0.0	25.0	13.0
% Car access	27.5	16.7	30.8	26.6	25.0	25.0
% Own a bicycle	22.5	41.7	100	100	100	55.0

The Chi-square test was performed on these data to test the coherence between the different variables and the phase of cycling behaviour. The found X^2 value of 7.06 for the relationship between gender and cycling behaviour does not exceed the critical value of 9.48 (df= 4, $\alpha = 0.05$). This means that there is no significant difference in cycling behaviour between men and women in the sample. Regarding distance, there were also no significant differences between the stages of behaviour. This means that students living at a far distance from the university are not necessarily in a lower stage of cycling behaviour. The same applies to car access, indicating that car access is not necessarily more common amongst students in the lower stages of cycling behaviour. However, it is important to remember that not every student with car access also uses the car to travel to university. Not surprisingly, bicycle ownership was found to differ significantly between the different stages of cycling behaviour. However, it is important to notice that several students in the pre-contemplation stage and half of the students in the contemplation stage are in the possession of a bike. This could mean that, although these students never or rarely cycled to the university campus, they do use the bicycle for other trip purposes, such as leisure or other daily activities.

4.1.2. Determinants of intention and the stages of cycling behaviour

In this section the results of the Pearson's correlation test for the determinants of cycling intention (convenience, physical and external barriers) are explained and further analysed. Because the sample size was small the chance of statistically insignificant results was relatively high. For this reason, the general opinion of the students (not distributed per stage of cycling intention) is also mentioned (in percentages) and explained when relevant. These percentages still offer an interesting general picture of which barriers the students perceive as most important to daily cycling in Dublin. The exact percentages of the other barriers per stage of cycling behaviour can be found in appendix 1.

Perceived Convenience

In table 3 the correlation matrix of perceived convenience is presented. Of the control variables the actual distance (not perceived) shows the most significant correlations with the independent variables. What is interesting is that actual distance also forms a positive correlation with cycling being fun. This finding corresponds with earlier studies in which it was also found that people who perceive cycling as fun often perceive distance less as a barrier (Handy et al., 2010). Also, students who are in the possession of a bicycle appear to have a more positive perception of the convenience benefits to cycling. Furthermore, considering the bicycle as the quickest transport mode to travel to the university is positively related to the perception that the bicycle offers more independence and flexibility in daytime and in the evening. Many of the students who perceive the bicycle as unpractical also perceive the bicycle as less fun. The following perceptions appear to have a significant positive relation with the stages of cycling behaviour: *'Cycling is the quickest transport mode for me to travel to university'*, *'The bicycle offers more independence and flexibility for daily (and evening) activities than other transport modes'* and *'Cycling is fun'*. Perceived barriers related to the bicycle being 'un-practical' and 'too time consuming' show a significant negative correlation with the stages of cycling behaviour.

Table 3. Correlation matrix ‘Lack of perceived convenience’ (N=100)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Gender	1											
2. Distance	-.091	1										
3. Car access	0.159	.183	1									
4. Bicycle ownership	-0.060	.193	.048	1								
5. Quickest transport mode	.074	-.231*	-.060	.255*	1							
6. Independence/flexibility (day-time)	.093	-.004	.088	.348**	.345**	1						
7.Independence/flexibility (evening)	.064	.151	.156	.316**	.151	.580**	1					
8. Fun	-.056	.246*	.081	.340**	.095	.310**	.362**	1				
9. Far distance to the university	-.021	.463*	.165	.070	-.383**	.102	.069	.040	1			
10. Unpractical	-.016	-.097	-.057	-.057	-.271**	-.179	-.149	-.264**	-.027	1		
11. Time-consuming	-.105	.224*	-.007	-.086	-.242*	-.199*	-.104	-.289**	.292**	.247*	1	
12. Commitments	.015	.118	.034	-.110	-.093	-.214*	-.085	-.214*	.122	.328**	.515**	1
13. Intention to cycle daily	-.038	-.002	.127	.651**	.436**	.485**	.276**	.331**	-.008	-.270**	-.239*	-.107

*p <.05 **p <.01

Perceived physical barriers

The perceptions related to physical and external barriers were calculated by the same procedure. The correlation matrices for these variables can be found in appendix 2. Regarding the physical barriers, uncertainty about cycling skills was found to weakly correlate with gender. A slightly higher percentage of females compared to men considered this as an important barrier. This corresponds with findings in other studies where the perceived unsafety is often higher under women than men (Short & Caulfield, 2014). The perception of 'hilliness' strongly correlates to 'cycling makes me tired' and 'confidence in cycling skills', which makes sense. However, only confidence in cycling skills appeared to differ significantly between the different stages of behaviour. In general, perceived physical barriers appear to be relatively unimportant to the students in the sample. Only 23% of all the students considered 'cycling makes me tired' as a barrier. This was expected, as earlier studies also found that physical barriers appear to be of relatively low importance for adolescents because the physical condition is generally reasonably fit (Heredia et al, 2014). However, 34% of all the students still mentioned 'lack of confidence in cycling skills' as an important barrier. This finding can also be related to the observation of external barriers and not only personal competence, such as perceived feelings of unsafety caused by motorized traffic.

Perceived external barriers

Of the external determinants, the listed barriers related to infrastructure, vandalism and weather appeared to be the most important for the students in the sample. With regard to the social image of daily cycling only 13% of all the students perceived 'judgements of others' as an important barrier. However, the statements 'cyclists are athletic, professional, require special equipment', 'most cyclists look like they can't afford a car' and 'I would feel strange on a bicycle' all show negative significant correlations with the stages of behaviour. Students in the lower stages of cycling behaviour appear to have a more negative perception of the social image of cycling. Looking at the overall percentage of the students, still 29% of the students agreed with the statement that cyclists are 'athletic, professional and require special equipment' also known as 'life-style cyclists'.

Perceived unsafety caused by the motorized traffic and feelings of personal insecurity when cycling after dark do not show significant correlations with the gradient of cycling intention. The larger part of all the students (60%), including the students in the more advanced stages of cycling behaviour, perceived unsafety caused by the motorized traffic as a very important barrier. A feeling of personal insecurity when cycling after dark seems to be a relatively less important barrier (26%) and is also not very differentiated between the

stages. This variable does show a significant correlation with gender; female students perceive it as a greater barrier than male students, which was expected.

The infrastructural barriers '*lack of cycle-lanes*' and '*low quality of the (cycle) road surfaces*' score high in perceived importance (resp. 65% and 62%). Also, 49.5% of the students perceive the '*lack of direct cycle routes*' as an important barrier. These high percentages result in insignificant correlations of the infrastructural barriers between the stages of cycle behaviour, because the perceptions do not differentiate so much per stage. However, these infrastructural barriers do show strong significant correlations with perceived unsafety and a feeling of personal insecurity cycling after dark. Furthermore, bike-theft seems to be an important barrier to 62% of the students. No significant correlation was found between the perception of bike-theft and the stages of cycling behaviour. However, this barrier does correlate significantly with perceived unsafety by motorised traffic. Feelings of unsafety might be interrelated resulting in a general idea of unsafety in regards to cycling in Dublin. Lacking complementary facilities such as adequate bicycle parking and the price of the bicycle are less important but still considered barriers (resp. 39% and 25%). For these variables no significant correlations were found with the stages of cycling behaviour. However, the price of the bicycle does show a significant correlation with low quality of the (cycle) road surface and adequate bicycle parking. This might imply that the students have the feeling that they need to buy an expensive bike for bicycle commuting.

Strikingly, the most important barrier for the students in this sample appeared to be the weather: 75% of the students perceived 'bad weather' as an important or very important barrier to daily cycling. For this reason this variable does not show a significant correlation with the stages of cycling behaviour, as students in all stages of behaviour perceived this barrier as important. What is interesting, is that perceived 'bad weather' as a barrier significantly correlates with the perceived lack of direct cycle routes and low quality of the (cycle) road surface. As was found in the literature, improved infrastructure can lower the importance of 'bad weather' as a barrier to daily cycling when the general comfort of the cycle trip increases.

5. Discussion and conclusion

5.1. Hypotheses and findings

This study examined if a difference can be found in attitudes and perceived barriers to daily cycling in different stages of cycling intention. The intended use of the bicycle as a daily transport mode appeared to be lower than expected among the students of Trinity College Dublin; 64 of the 100 students were still in the pre- contemplation or contemplation stage of behavioural change (H1). As it was found that the used sample is not representative for the whole population, these findings cannot be extended to the whole population of the university. However, the study does provide an indication of the barriers to daily cycling noticed by ‘young’ people in Dublin.

The attitudes and perceived barriers appear to differentiate mainly between the earlier stages of intention and behaviour (pre-contemplation and contemplation) and later stages (action and maintenance). With regard to the hypotheses put forward in the theoretical framework the following answers can be formulated: Perceived convenience of the bicycle appeared to be significantly higher in more advanced stages cycling behaviour (H2). Also, the perceived distance is less important to cyclists who think cycling is fun (H3). For the students the physical barriers appeared to be of less importance in comparison with convenience and external barriers. However, ‘confidence in cycling skills’ did show to be more important to the students in the pre-contemplation stage (H4). Furthermore, the social image of cycling appears to be a greater barrier for students in the earlier stages of intentional behaviour than to students who already cycle regularly (H5).

The external barriers did not differ significantly between the stages of intention. This means that the hypotheses from 6 up to and including 10 cannot be verified on the basis of this sample. However, these results still offer other valuable insights into which barriers are considered important in general. The external barriers related to perceived unsafety on the road, infrastructure, vandalism and the weather were all marked as important by most of the students. This ensures that no significant differences were found between the different stages of intention. However, these findings do alter the perceived importance of these individual barriers. For example, several studies found that perceived unsafety becomes less of a crucial barrier for individuals with more cycling experience because perceived unsafety is often an overrated estimation of actual unsafety (Lawson et al. 2013; Rietveld & Daniel, 2004). However, the fact that the larger part of the students in the higher stages of cycling behaviour (action and maintenance) still experiences unsafety as an important barrier, allows for concern about safety levels in Dublin. Also, ‘bad weather’ appeared to be the most important barrier for the students, high percentages were found in all stages of cycling behaviour. One

might conclude that the climate of Dublin is not suitable for cycling. However, levels of rainfall in Dublin are similar to that of cycling capitals Amsterdam and Copenhagen, which implies that the importance of bad weather as a barrier to daily cycling can be mediated by other factors, such as improved infrastructure (Caulfield, 2014). This indicates that other structural facilities that could improve the feeling of comfort of the cyclist are still lacking in Dublin. This statement is also supported by the fact that the largest part of the students, no matter the stage of cycling behaviour, considered infrastructural shortcomings as important barriers to daily cycling. Furthermore, the risk of bike theft in Dublin was also perceived as an important barrier to students in all stages of behaviour.

The limitations of this research are related to the relatively low amount of respondents in the sample and the fact that the sample scored low on representativeness for the whole population of the university. Also, the fact that only subjective perceptions were included in the analysis neglects the possible influence of other objective factors not perceived by the individual. It was out of the scope of this thesis to include other factors, but further research should take this into account.

Other limitations are related to the research method used. The Pearson's Correlation test only offers insights in the direction and the strength of the correlation. Further conclusions cannot be made solely based on this test. Unfortunately, it was out of the scope of this study to examine the effect of the perceived barriers in more detail. Performing logistic regression analyses on these data could offer additional valuable in-depth information. Another critical remark can be made with regard to the use of the Pearson Correlation test. It is questionable if 'the intention to cycle' can actually be considered to be an ordinal variable (a prerequisite for the Pearson Correlation test). This has to do with the additional 5th 'relapse' phase. A positive attitude relating to the general image of cycling as a convenient transport mode is mostly present among the respondents in this group and the experience of social and physical barriers is similar to cyclists in the action or maintenance phase. However, individuals in the relapse phase often perceived more specific barriers, examples are: they moved too far away from the university campus or they did not have a bicycle in Dublin because they were international students visiting the university for a short period. This made it hard to classify the measured intention of this group for this sample. If the relapse phase is considered as a group with a low intention to cycle daily, then the dependent variable (the intention to cycle) could not be considered as ordinal and the Pearson Correlation test would not be suitable anymore. In this case only a Chi-squared test could have been performed. This uncertainty lowers the internal validity of this study. Furthermore, this study tried to establish causal relationships between the different socio-demographic characteristics, perceived

barriers and the intention to cycle. However, examining causality ideally requires more sophisticated research methods. Pucher et al. (2010) emphasize on the importance of the use of ‘an intervention’ in the research design, for example, a certain bicycle facility. In this way bicycle use can be measured before and after the implementation of this intervention. However, despite its shortcomings this thesis still offers a deeper understanding of the cycling barriers that are important to ‘young’ people in Dublin. These findings offer new information on which policy innovations and other research could be based. In this way more effective strategies to increase bicycle use can be developed.

In conclusion, based on this study it seems unlikely that a bicycle culture is already emerging among the students of Trinity College Dublin. It is argued that focusing on the ‘younger’ generation could be the key in accelerating the transition of Dublin to a more sustainable cycling-friendly capital. The findings of this study show that students in Dublin still perceive many barriers to daily cycling, even when they are cycling already. It is shown that the improvement of structural barriers only will not necessarily lead to more people taking up daily cycling. Other socio-physiological barriers need to be understood and addressed. In order to motivate more students to take up daily cycling and to stimulate the existing intention among some students, more attention should be given to the transport desires and demands of the younger people in Dublin. Only in this way a new generation can be established that slowly moves away from car-centred ideas. A bright and sustainable future for Dublin starts with changing the mind-set of the future generations.

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Appendix 1: Percentages attitudes & barriers per stage of cycling behaviour

Percentages are summed per stage of behaviour and per variable (for attitudes: agree + strongly agree and for barriers: important + very important).

Table 1. Perceived convenience per stage of cycling behaviour

	PC (n=40)	C (n=24)	A (n=13)	M (n=15)	RE (n=8)	Overall (n=100)
Convenience						
Attitudes						
% Quickest transport mode	25	33.3	77	86.7	50	45
% Independence & flexibility (day)	55	70.83	84.6	93.3	100	72
% Independence & flexibility (evening)	65	75	84.6	73.3	87.5	70
% Cycling is fun	52.5	79.2	91.6	100	75	72.7
Barriers						
% Far distance to the university campus	35	58.3	38.5	33.3	50	42
% Change clothes/carry things	65	58.4	46.2	40	50	56
% Commitments before and after going to university	32.5	33.3	38.5	13.3	37.5	31

*Numbers in bold are higher than the average.

Table 2. Perceived physical barriers per stage of cycling behaviour

	PC (n=40)	C-PA (n=24)	A (n=13)	M (n=15)	RE (n=8)	Overall (n=100)
Physical barriers						
% Confidence in cycling skills	55	25	15.4	26.7	0	34
% Cycling makes me tired	27.5	33.3	7.7	0	37.5	23
% Hilliness	35	50	38.5	26.7	37.5	29

*Numbers in bold are higher than the average.

Table 3. Perceived external barriers per stage of cycling behaviour

	PC (n=40)	C-PA (n=24)	A (n=13)	M (n=15)	RE (n=8)	Overall (n=100)
External barriers						
Social image						
% Feel strange on bicycle	30	8.3	0	0	12.5	15
% Judgements of others	20	8.3	15.4	6.7	0	13
% Many friends cycle	47.5	58.3	46.2	46.7	37.5	49
% Most cyclists look like they can't afford a car	10	0	0	0	0	10
% Cyclists are athletic, professional, require special equipment ("life-style" cyclists)	32.5	37.5	15.4	20	12.5	29
Safety						
% Unsafe because of motorized traffic	65	75	38.5	46.7	50	60
% Personal security	30	29.2	23.1	13.3	25	26
Infrastructure						
% Lack of cycle lanes	35	66.7	69.2	66.7	62.5	65
% Lack of direct cycle routes	45	62.5	53.8	35.7	50	49.5
% Low quality (cycle) road surface	47.5	66.7	76.9	73.3	75	62
Vandalism						
% Bike theft	57.5	66.7	61.5	66.7	62.5	62
Complementary facilities						
% Lack of adequate bicycle parking	35	45.8	30.8	35.7	62.5	39
% Price of the bicycle	30	21.7	30.8	26.7	0	25.3
Environmental						
% Weather	70	79.2	84.6	66.7	87.5	75

*Numbers in bold are higher than the average.

Appendix 2: Correlation matrices

Table 1. Correlation matrix ‘physical barriers’ (N=100)

	1.	2.	3.	4.	5.	6.	7.
1. Gender	1						
2. Distance	-.091	1					
3. Car access	.159	.183	1				
4. Bicycle ownership	-.060	.193	.048	1			
5. Cycling makes me tired	.034	-.001	-.105	-.194	1		
6. Confidence in cycling skills	.288**	-.044	-.075	-.248*	.235*	1	
7. Hilliness	.059	.147	-.017	-.071	.495**	.209*	1
8. Stage of cycling behaviour	-.038	-.002	.127	-.651**	-.184	.281**	-.043

*p <.05 **p<.01

Table 2. Correlation matrix 'external social barriers' (N=100)

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Gender	1								
2. Distance	-.091	1							
3. Car access	0.159	.183	1						
4. Bicycle ownership	-0.060	.193	.048	1					
5. Cyclists are athletic, professional, require special equipment	0.73	.096	-.146	-.202*	1				
6. Most cyclists look like they can't afford a car	-.118	.010	.014	-.288*	.012	1			
7. I would feel strange on a bicycle	.058	-.056	.118	-.394**	.171	.413**	1		
8. Many of my friends cycle	.023	-.143	-.026	-.067	-.194	-.048	-.027	1	
9. Judgments of others	.017	-.013	-.118	-.101	.043	.087	.245*	.140	1
10. Stage of cycling behaviour	-.038	-.002	.127	.651**	-.200*	-.299**	-.477**	.016	-.168

*p <.05 **p <.01

Table 3. Correlation matrix external barriers (safety, infrastructure, vandalism, facilities, weather)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Gender	1												
2. Distance	-.091	1											
3. Car access	0.159	.183	1										
4. Bicycle ownership	-0.060	.193	.048	1									
5. Unsafe	.128	-.130	-.086	-.192	1								
6. Personal security	.474**	-.069	.020	-.116	.405**	1							
7. Lack of cycle lanes	.225*	.021	.127	-.048	.496**	.391**	1						
8. Lack of direct cycle routes	.296**	-.124	.019	-.130	.538**	.562**	.609**	1					
9. Low quality (cycle) road surface	.230*	-.086	0.012	-.068	.352**	.491**	.613**	.690**	1				
10. Vandalism	.035	-.185	.124	-.024	.308**	.172	.147	.284**	.260**	1			
11. Lack of adequate bicycle parking	.153	.120	.164	.021	.112	.216*	.346**	.394**	.461**	.288**	1		
12. Price of the bicycle	.106	.012	-.093	-.151	.126	.280**	.162	.108	.185**	.196*	.324**	1	
13. Weather	-.115	.108	-.049	.041	.169	.204*	.162	.257*	.281**	-.023	-.049	-.050	1
14. Stage of cycling behaviour	-.038	-.002	.127	.651**	-.187	-.167	-.051	-.069	.171	.024	.101	-.125	.109

Appendix 3: Survey: Cycling in Dublin

This survey is developed to research the opinion of students in Dublin about cycling as a daily transport mode. Completing the survey takes no longer than 5 minutes and all the answers will be processed anonymously.

1. What is your age?:

2. What is your gender?:

- Male
- Female

3. Are you:

- Undergraduate student
- Postgraduate student
- Visiting student (1 or 2 semesters)
- Other:

4. What faculty do you study at?:

- Arts, Humanities and Social Sciences
- Engineering, Mathematics and Science
- Health Sciences

5. What is your nationality?

.....

6. What is the approximate distance from your home to the university campus?:

- Less than 2km
- 2-4km
- 5-7km
- 8-10km
- More than 10km

9. Do you have access to a car?

- Yes
- No
- I don't have a driving license

10. Do you own a bicycle?:

- Yes
- No

11. Which statement about cycling to university applies to you?:

- I never really think about and don't even consider cycling to university*
- I never used a bicycle but sometimes think about cycling to university*
- I rarely use(d) a bicycle but I seriously consider cycling to university*
- I cycle fairly often to university*
- I cycle (almost) always to university*
- I used to cycle to university but not anymore*

12. Please rate your level of (dis)agreement with the following statements:

	Strongly disagree	Disagree	Partly (dis)agree	Agree	Strongly agree
Cyclists are athletic, professional, require special equipment ("lifestyle" cyclists).					
Cycling is the quickest transport mode for me to travel to the university campus.					
Most cyclists look like they can't afford to own a car.					
I would feel strange on a bicycle.					
Many of my friends cycle.					
Cycling offers more independence and flexibility than other transport modes (arrive/depart when I want) for daily activities during the week and in the weekend.					
Cycling offers more independence and flexibility than other transport modes (arrive/depart when I want) for evening activities during the week and in the weekend.					
Cycling is fun.					

13. Rate to what degree the following reasons/factors had an impact on your decision to not cycle OR (could) lead you to use the bicycle less than intended:

	Not important at all	Not important	Neutral	Important	Very important
Distance to the university campus.					
Cycling makes me tired.					
The lack of adequate bicycle parking.					
Unsafety caused by motorized traffic.					

	Not important at all	Not important	Neutral	Important	Very important
I would need to change clothes / carry things.					
Lack of cycle lanes.					
Hilliness.					
Price of the bicycle.					
Cycling is too time-consuming.					
Attitudes and behaviour of other road users and pedestrians.					
The chance of bicycle theft.					
Confidence in cycling skills.					
I feel unsafe about my personal security cycling alone after dark.					
Lack of direct cycle routes.					
Quality of (cycle) road surface.					
Weather.					
Judgments of others.					
Many commitments before and after going to university.					

15. Under what circumstances would you be willing to cycle (more often)?:

- Under no circumstances
- I would be willing to cycle (more often) if:

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End of the survey.

Thank you very much! 😊