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ANALYSIS OF THE CYCLE LEVELS IN MAJOR TOWNS AND CITIES IN ENGLAND

CAMILA MEGALE DE AGUIAR

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Para meus pais, irmã e Scott

“Cities are an immerse laboratory of trial and error, failure and success, in city building and city design”

Jane Jacobs

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ABSTRACT

The idea of the bicycle as a major transport mode in the urban environment has become very popular among European countries. Cycling for utilitarian purposes can have a positive impact on the city's health, environment and economy. To cycle be consolidate in urban life is important that local government set up strategies and policies for the promotion of the bicycle. It is fundamental the investments in infrastructure and the development of a network so that cyclist can safely and easily move around the city.

The English cycle level is very low when compared with other European countries. Most of this lower rate is due to the lack of government engagement in promoting efficient strategies to embrace cycling. However, over the past decade, stronger local cycling strategies have begun to be developed and implemented around the territory.

To better comprehend how the cycling levels are changing on a national and local scale, sixteen major towns and cities in England were selected to analyse the changes in the cycling levels from 2011 to 2019. A cross data analysis of the main policies and programs that existed, the presence of cycle infrastructure and the terrain with the level of cycling growth of each town and city was made to understand how these factors affect the cycle levels.

After this research, the results show that there is an increase of the cycling levels in most of the towns and cities and proved to us that the presence of a balance of local and national policies with the promotion of infrastructure is one of the main ways to guarantee constant growth. This demonstrates that England can become a cycling nation.

KEYWORDS: Utilitarian Cycling, Cycle Level, England, Policies, Promotion.

RESUMO

O uso da bicicleta como um principal modo de transporte no ambiente urbano se tornou um tema muito popular entre os países europeus. A bicicleta para fins utilitários pode ter um impacto positivo sobre a saúde, o meio ambiente e a economia da cidade. Para consolidação da bicicleta na vida urbana é importante que o governo local estabeleça estratégias e políticas para a promoção da bicicleta, é também fundamental o investimento em infraestrutura e o desenvolvimento de uma rede para que o ciclista possa se locomover com segurança e facilidade pela cidade.

O nível de ciclismo inglês é muito mais baixo quando comparados como de outros países europeus. A maior parte deste baixo índice se deve à falta de envolvimento do governo na promoção de estratégias eficientes para a adoção do ciclismo utilitário. Entretanto, durante a última década, fortes estratégias locais de ciclismo começaram a ser desenvolvidas e implementadas em todo o território.

Para uma melhor compreensão de como os níveis de ciclismo estão mudando em escala nacional e local, foram selecionadas dezesseis principais cidades da Inglaterra para entender as mudanças nos níveis de ciclismo de 2011 a 2019. Uma análise cruzada dos dados das principais políticas e programas existentes, da presença da infraestrutura cicloviária e do terreno com o nível de crescimento do ciclismo de cada cidade para compreender como esses fatores afetam os níveis de ciclismo

Após este estudo, os resultados mostram que há um crescimento nos níveis de ciclismo na maioria das cidades e que a presença de um equilíbrio nas políticas locais e nacionais com a promoção de infraestrutura é uma das principais formas de garantir um crescimento constante. Isto mostra que é possível para a Inglaterra se tornar uma nação ciclista.

PALAVRAS-CHAVE: Ciclismo Utilitário, Nível de Ciclismo, Inglaterra, Políticas, Promoção.

SUMMARY

FIGURES INDEX

TABLE INDEX

SYMBOLS, ACRONYMS AND ABBREVIATIONS

BMI – Body Mass Index

BSS – Bike-Sharing System

CCA - Cycle City Ambitions

CCTs - Cycle Cities and Towns

CDT - Cycling Demonstration Towns

CWIS- Cycling and Walking Investment Strategy

DtT – Department for Transport

LCWIPs – Local Cycling and Walking Infrastructure Plans

LTP- Local Transport Plan

NCN- National Cycle Network

NCS - National Cycling Strategy

1 INTRODUCTION

1.1. PRESENTATION

The use of the bicycle in urban life started at the beginning of the XIX century and it has been facing challenges ever since the arrival of automotive transport in our society. With the advances of automotive transport, human-powered machines have started to be marginalized in our cities. Once used as primary modes of transport, in today's society, the bicycle is mostly used for leisure and recreation purposes.

The importance of the bicycle as a transport mode only started to get the attention of urban planners and policy makers in the 1970s, motivated mainly due to the Middle East oil crises and the empowerment of environmental organizations. Due to this oil crisis, the cost of petroleum fuelled vehicles became less efficient to own and along with the realised environmental damage from using fossil fuels policy makers looked to decrease the reliance on automotive transport. One of the solutions found was the promotion of cycling and walking for smaller journeys.

The investment in cycling policies and the required infrastructure was only embraced on a global scale since the start of 2000. Countries such as the Netherlands, Germany, and Sweden have been investing in cycling policies for much longer than others. They notably have one of the highest levels of cycling for utilitarian purpose per capita, which has a direct correlation to the carbon emotions per capita (The Guardian, 2016). The English cycling levels are considerably lower than the European standard, only Cambridge and Oxford have cycling rates similar to European countries, such as the Netherlands (Goodman, 2013).

Current cycling policies in England started to be established in the late 1990s, given two decades to develop there is a clear disparity between England and other European countries. This work aims to understand cycling policies across England and their effectiveness in different regions. This is achieved by analysing cycling levels, policies, local council schemes and infrastructure to determine the success of each region. This will highlight the effective strategies that can be used to implement cycling into urban environments.

1.2. OBJECTIVES

- Identify the main policies and infrastructure used to promote and consolidate the bicycle in cities and identify the major's benefits and obstacle of promoting this transport mode.
- Analysis of sixteen towns and cities across England, two from each county excluding Greater London.

- This work aims to analyse the main policies and programs that are in place, as well as the physical environment, including topography and infrastructure, to show how they influence the local cycling levels.
- The evaluation of similarities and differences of promoting cycling in England and their effectiveness.

1.3. METHODOLOGY

To conduct this research, the methodology used was a bibliographic study relating the cycling levels in England, through books, articles, texts, magazines and other academic internet sources, such as Science Direct, Taylor & Francis and Research Gate.

First, a historical overview was made to focus on understanding the context of the technological evolution of the bicycle and the impact that the development of this new transport mode had on your society. Second, a theoretical study was carried out to identify the major's advantages and barriers to promoting biking and identifying the major infrastructures and policies that are used to promote and increase cycling. From that, it is possible to understand the real impact of cycling in your cities and what is necessary to increase cycling levels. Then, it was important to understand the emergence of the main UK policies to promote cycling. This historical overview enables a better understanding of the English cycling scenario and comprehends the government's involvement and vision for cycling.

For the analysis of the study case, a documentary study was made from the UK government website, from data from the Office of National Statistics and the Department of Transport. For the local analysis was use the city council websites for detail of local and regions specificities. The main documents analyse are the Local Transport Plans, Local Cycling and Walking Infrastructure Plan. This information collation provided data on how policies, infrastructure and the terrain can positively and negatively impact the cycling levels of major towns and cities in England.

2
THE HISTORICAL EVOLUTION OF THE BICYCLE

2.1. INTRODUCTION

The presence of the bicycle in your life is so constancy that is hard to notice the importance of the bicycle in the world. There are more the one billion bicycles in the world, used daily in cities for utilitarian and recreational purposes, but there is an absence of interest in their history and technological evolution (Hadland & Lessing, 2014). This lack of interest and appreciation is due to motorized vehicles. In summary:

The bicycle was more than just a mechanical breakthrough, also contributing to technological advances, social transformations which changed the mobility patterns of urban environments (Hadland & Lessing, 2014; Smethurst, 2015; Bopp et al., 2018). In the technological aspect, the bicycle industry developed a successful system of mass production with efficient strategies of marketing and distribution that later was adapted by the automobile industry. The social changes were focused on the working class, where the bicycle became the first vehicle that was financially accessible for a major part of the population, and for the contribution on changes in the social behaviour that led to the gain of women's rights. With the popularization and the wider acceptance of this new vehicle, it became evident that the cities would have to invest in better roads for the riders, and develop a national network since it was becoming easier for people to travel longer distances.

The evolution of the bicycle came from multiple experiments. In the beginning, this new vehicle was dangerous, risky and an expensive hobby, but with the advances of technology and the development of safer design and price reduction, the bicycle became a fundamental way of transport during the 20th century (Herlihy, 2004; Hadland & Lessing, 2014). During this period, this machine was associated with the future, a symbol of modernisation. Today, there is a recycling of the concept of the image of this machine, standing now for sustainability and as a retro fashion icon (Smethurst, 2015).

Taking into consideration the impact on the technological and social aspect, this chapter will give a brief overview of the evolution of the bicycle. Firstly, focus on the technological advances that started with experiments of a two-wheel machine until the development of what we know as the modern bicycle. It will highlight the most popular models that shaped the development of the machine. Secondly, it will cover the social and cultural impact of the consolidation of the bicycle in the modern world. There will be a focus on the understanding of the main impact of the popularization of the bicycle, and the repercussion that is made in the transport industry and society.

2.2. THE TECHNOLOGICAL EVOLUTION OF THE BICYCLE

There is a record, from the start of the 19th century, of experiments of human-powered two-wheel transport. These inventions were an attempt to create a new way of transport that did not depend on horses (Hadland & Lessing, 2014; Bopp et al., 2018; Malizia & Blocken, 2020). However, due to the high price and the risk of accidents, the inventions became associated with the leisure of the young, wealthy, thrill-seeking men.

There are many claims about who invented the first bicycle. Most of the allegations are about concepts and ideas that never been build (Smethurst, 2015). The main literature (Herlihy, 2004; Hadland & Lessing, 2014; Smethurst, 2015) claim to the German Karl Von Drais was the inventor of the first bicycle, when he developed the two-wheel machine around 1817. The invention consisted of two miniature carriage wheels in a line connected through a wooden frame with a cushioned seat.

Figure 1 - Draisiane or Hobby Horse. Source Museum of Applied Arts & Science, 27/05/2021, (https://collection.maas.museum/object/207233).

The invention was known as ‘draisiane’ or ‘velocipede’, which in Latin means fast foot (Herlihy, 2004; Hadland & Lessing, 2014). The main idea behind Drais invention was not only to simplify the walk but to accelerate daily activity with a minimum effort. This machine could go up to six miles an hour, twice the walking speed, and when run, could reach twelve miles an hour, making the machine the faster way to locomote at the time (Herlihy, 2004).

The draisine faced many criticisms and negative press, especially in England, where got the nickname of ‘hobby-horse’. This advertising contributes to the association of a negative image for the draisine, classified as dangerous and more an item of amusement for adventurous men (Herlihy, 2004). Even with the criticism that the draisine encountered, the idea of a two-wheel human-powered machine started to spread around Europe. The machine marks the emergence of the principle of a two-wheel steerable vehicle, one of the first steps taken to the development of the basic bicycle (Herlihy, 2004; Hadland & Lessing, 2014; Smethurst, 2015).

The next mark came in 1867 with the emerge of the original French bicycle, the first design of a two-wheel machine pedal-powered. The invention was created by an obscure blacksmith named Pierre Michaux and announced by all the major magazines at the time (Herlihy, 2004). The French pedal

breakthrough came as a surprise due to the lack of interest in the first velocipedes but, with the pedal breakthrough, the new machine obtained more public acceptance. The new model created by Michaux was made of solid iron and the wheels are placed closer and bigger than the draisine (Herlihy, 2004). The pedal and the cranks were placed straight to the front hub and the motion achieved when the feet of the rider spun the pedal. The development of this new mechanical crank allows the machine to sustain a speed up to eight miles an hour, making this design into a genuine vehicle (Herlihy, 2004).

Figure 2 – Michaux-type Velocipede, c.1869. Source Museum of Applied Arts & Sciences, 27/05/2021(https://collection.maas.museum/object/207234).

With the popularity of the French bicycle, some new features started to appear to make the use of the machine more enjoyable for the rider. Some of these improvements were the use of leather seats for absorption of impact, adjustable pedals and seats to adapt to different sizes riders, and a brake system to give more safety (Herlihy, 2004). There is a register of some of this machine with rubber tires, for more absorption of the impact, but this new improvement faced reluctance from the riders.

Even with the general disbelief and the higher cost of the bicycle, the Michaux design succeeded in obtaining people acceptance and started to become popular among rich young men. The popularity of this new design was achieved when Pierre Lallement patent this model and took it from Paris to the United States, where was well received by the adventures men's (Herlihy, 2004). With the acceptance increasing in France, Great Britain and America, some small groups started to emerge to compete and race each other. With the motivation to create faster bicycles, in these groups, they would be constantly trying to improve and increase the speed of their vehicle (Herlihy, 2004). The solution found was by an adaptation of the design of the bicycle with an increase in the diameter of the wheel. The use of a bigger wheel would provide a higher path length travel in a crank revolution, therefore increase the velocity (Smethurst, 2015; Malizia & Blocken, 2020).

With this new need, the high wheeler started to emerge around the English cities in the mid-1870. The most popular profile was the full-blow high wheeler, with a front wheel up to sixty inches, and a trailing wheel of sixteen inches (Herlihy, 2004; Hadland & Lessing, 2014). Besides the high front wheel, there

were some changes from the French bicycle designs such as the use of steel tubes and the wider use of rubber around the wheels (Herlihy, 2004).

Figure 3 – Star British Challenge Penny Farthing made by Singer&Co., Coventry, England, c. 1885.
Source Museum of Applied Arts & Sciences, 27/05/2021, (https://collection.maas.museum/object/242328).

This configuration was later designated by the press and the population as the 'Ordinary' or 'Penny-Farthing' in the UK (Hadland & Lessing, 2014). This new design was well accepted by society and was viewed as a representation of scientific precision engineering exalting mathematical perfection (Smethurst, 2015). With the years and the advances of the industry, the 'Ordinary' gain some improvements and changes to make the bicycle more comfortable and able to go faster. It was added seat springs, to make more comfortable, hollow tubes, to make it lighter, the 'moustache' bar that gave more room for the rider knee and allowed more control of the machine. Some accessories could be added if the ride required, such as oil lamps, tool kits and cyclometers (Herlihy, 2004).

The dominance of the high wheel lasted for around thirty years when, by the end of the mid-1880s, started to grow fear related to the high risk of accidents and the low level of security and stability offered by the model to the rider. The high size of the front wheel made it difficult for a non-trained person to start a ride and promoted less stability when riding, making the rider more vulnerable to accidents (Herlihy, 2004; Hadland & Lessing, 2014). The consolidation of the sport races and competitions with the 'Ordinary' motivated the bicycle community to invest in technical development for faster and more efficient design. The 'Ordinary', that was praised for the elegant design and engineering precision, it was necessary to pass through a major design change for the bicycle evolution (Hadland & Lessing, 2014)

With that, a new model was developed with an equal size wheel that allowed the rider to sit more comfortably and have more control over the bicycle. The emergence of the Rover, the newest rival for the high wheel, consisted of equal size wheels with a chain driver, created by John Kemp Starley (Herlihy, 2004). The frame of the new design was made of curved tubes, and the total weight of the rover was under forty-five pounds. The bicycle also had adjustable seats and handlebars to fit better the

rider. By 1885 all major British cycle industry is producing the new model with rear-drive safety bicycle when it was introduced to the public on the annual Stanely Show in London (Hadland & Lessing, 2014).

Figure 4 – The Rover 'Safety' bicycle, c. 1885. Source Science Museum Group Collection, 27/05/2021, (https://collection.sciencemuseumgroup.org.uk/objects/co25833/rover-safety-bicycle-1885-bicycle).

There were three major changes from the 'Ordinary' to the Rover, regarding the size of the wheels, the use of chain drive and the development of the diamond frame. The use of the chain wheel allowed to change from the direct front wheel drive, as used in the 'Ordinary', to an indirect rear wheel drive (Hadland & Lessing, 2014). The adoption of indirect propulsion made possible the use of equal size wheels and maintaining the same speed with less effort of propulsion from the rider. The development of the diamond frame came through a process of adaptation to find the best structure to fit the chain drive but also that had flexibility and strength (Herlihy, 2004; Hadland & Lessing, 2014). Another profound change was the use of pneumatic tires. The idea of inflammable tires was seen as negative at first but, by 1888 this new feature was easily accepted due to the elevated level of absorption that the tires provided (Herlihy, 2004; Hadland & Lessing, 2014; Smethurst, 2015). With that, this new machine was able to produce the most efficient, comfortable, and safer experience for the rider.

This new model of the bicycle was known as the safety bicycle due to the constant search for a safer machine. Even with the initial scepticism from the public this new model was well accept by the population. The new design allowed the machine to be used not only as a sport or leisure activity as it was with the Ordinary, but it allowed the bicycle to reach the utilitarian purpose that was a dream by Drais (Smethurst, 2015).

One of the major differences from the safety bicycle from the previous model was the ability to lower the price of the vehicle due to the development of advanced techniques of mass production to assemble the bicycle. With the prices, more affordable enable the reaches of the bicycle throughout the society, including workers, women and children and use for services, such as delivery and police reinforcements, and not be as an exclusive entertainment for the rich and adventures men (Herlihy, 2004).

Consolidation of the safety bike has been so strong that is present to this day. The establish of the safety bicycle mark was the beginning of the development of what we know as the modern bicycle (Herlihy,

2004; Hadland & Lessing, 2014). To this day, most of the major features developed by the safety bicycle such as the use of chain drive and the diamond frame, are still used on the modern bicycle. Some new improvements were developed over the years such as chain with multiple gears, that would make the rider adapt to different terrain, better brake systems, more efficient suspensions to absorb the road impact, different design of handlebar, pedals and saddles for different types of bicycles that can present better results for specific tasks (Hadland & Lessing, 2014).

Figure 5 – The main popular modern bicycle. Source Edinburgh Bicycle Cooperative, 2020, (https://www.edinburghbicycle.com/info/types-of-bikes-buying-guide/)

There has not been any major change in the bicycle design and concept since the popularization of the safety bicycle, but there has been some adaptation, so the vehicle fits into the 21st century. There is the development of a different model for different activities such as race bicycle, mountain bike and compact/folder bicycle, as is shown in figure 5 (Hadland & Lessing, 2014). The model that is obtain more popularity over the years is the electric bikes, which is an attempt to adjust the bicycle concept into the car-centric urban scenario. Now the emphasis is not on changing the basic shape of the bike but making it relate to the new social trend and perception; and reinvent the bike culture (Smethurst, 2015).

2.3. THE SOCIAL AND CULTURAL IMPACT OF THE POPULARIZATION OF THE BICYCLE

The technological advances of the bicycle allowed the vehicle to gain more space in urban life causing a social, cultural, and economic impact that helped shape your society. Many authors (Herlihy, 2004; Hadland & Lessing, 2014; Smethurst, 2015; Bopp et al., 2018) have highlighted the impact of the bicycle's evolution goes beyond mechanical and technological discoveries. Also changing the way people move in cities, giving freedom and opportunities to workers and women and helped establishes a mass production system that shapes the car industry.

The popularization of the bike at all levels of society was achieved by the end of the 19th century when it became more affordable and accessible to the working class (Bopp et al., 2018). One of the main factors that allowed more accessible prices for the bicycle was the innovation in the manufacturing

process of building and assembling pieces. With the emergence of the industrial complexes, it provided the knowledge necessary to mass production the bicycle, making it possible to lower the prices of the vehicle (Smethurst, 2015).

The mass production made the bicycle available for a large part of the population by 1930. The development of mass production and the use of standardised parts made it possible not only to reduce the price of the vehicle but also facilitated maintenance and repairs, making it more cost-effective (Smethurst, 2015). All the previous bicycle design, such as the Ordinary and the French bicycle, were hand build, and even that the production of this machine was high for the period, was only with the mass production of the safety bicycle that this vehicle reached the peak. These changes of the industrial production made by the bicycle led to technological innovation into the development of new cultural conditions that encouraged mass consumption (Herlihy, 2004; Smethurst, 2015). These new forms of marketing, advertising and distribution were set up by the bicycle industry, which later was adapted to the automotive industry.

Another change brought by the evolution of the bicycle was in the social sphere. The consolidation of the bicycle affects not only the wealth, but it helped broaden the city and the social life for a lot of the working class and women. In the working-class scenario, the mobility achieved by the bicycle allowed the vehicle to become the main way of transport between home and work, giving the utilitarian meaning to the bicycle (Smethurst, 2015). Besides that, given more freedom for the working class to move around the city and explore beyond their domestic bubble contributing to the break of the social barriers of the society at the time.

This new social function of the bicycle allowed changes in the urban planning of industrial cities. The bicycle mobility facilitated the zoning of the urban space, made possible the idea of people using this vehicle to commute to work, allowing the works to live in suburban areas and use the combination of bicycle and train to go to work. Some of the garden cities in England and others new housing and industrial states started to be planned to take into consideration the new concept generated from bicycle mobility (Smethurst, 2015).

Another social impact from the bicycle culture was the contribution to the gender difference fight that began at the end of the 19th century. The mobility and the freedom gain with the bicycle open ‘new’ social spaces for the women that were unreachable before. With the spread of the New Women feminist ideals, they use the bicycle popularity and reach as a tool to help them gain their space (Herlihy, 2004; Hadland & Lessing, 2014; Smethurst, 2015; Bopp et al., 2018). It helped them entering cycling clubs and society that was exclusive for men and contributed to expanding women's social life and gain of independence. Furthermore, the bicycle has stimulated the breaking of restricted social dress codes by the use of fewer restraint clothes that allow them to perform the physical activity of riding the bike easier (Bopp et al., 2018).

These changes and the empowerment of the women in the society received lots of criticism, even the idea of women riding a bicycle was seen as extremely inappropriate and even considered as medically dangerous at the time (Herlihy, 2004; Smethurst, 2015; Bopp et al., 2018). The end of the 19th century was marked by the beginning of gender equality spread in society, even though this movement evolved way more than just a mobility focus, is important to notice and recognise the significant role that the emergence of this machine had in helping change the social and cultural landscape its time (Herlihy, 2004; Hadland & Lessing, 2014; Smethurst, 2015; Bopp et al., 2018).

The changes promoted by the bicycle culture, even that concealed by the automobile industry, helped shape the society and the cities that we have until this day. Since the popularization of the car in urban centres, the bicycle has become seen as an item of leisure and entertainment, losing much of the

utilitarian purpose present at the beginning of the 19th century. Most of the importance of this vehicle can pass unseen in cities and the urban life. However, with the progress of the impacts of climate change and pollution levels in the cities in recent decades, the bicycle culture has been reborn as a solution to the mobility and transportation problem. A new image has been created for the bicycle as a sustainable and carbon-free vehicle that can help minimize the environmental impact and improve life in the city. With this new sustainable approach, the bicycle is trying to leave its mark on this new society.

3
CYCLING AS A TRANSPORT: BENEFITS, OBSTACLES AND PROMOTION

3.1. INTRODUCTION

The use of the automobile as a main mode of transport contributed to the development of car-centric and car-depended cities, making other forms of transport such as cycling unsafe and challenging (Bopp et al., 2018). Despite the car dominance, some countries have been investing in cycling since the 1970s, in an attempt to make it a major transport choice in urban life due to the negative impacts that motor vehicles can generate on the environment and on the city.

The trend of cycling investments only became more popular around the countries from 2000 to the present, due to the increase of research focused on identifying the impact and effectiveness of cycling. These studies mostly highlighted the positive impacts that cycling can have on the individual level attracted by the beneficial outcomes of cycling, policy makers and local governments began to look for a more efficient way to promote and invest in cycling (Pucher et al., 2010). Many studies have highlighted the positive impacts of cycling such as the health, environmental and economic aspects, but even with the positive effects of cycling, this transport mode still is strongly associated with lack of safety, risk and exposure to road traffic (Bopp et al., 2018). Thus, policy makers soon realize that, would be necessary to create policies and infrastructure to stimulate more cycling, allowing the bicycle to slowly regain its presence in the transport network.

This chapter will analyse the main literature surrounding cycling in cities, aiming to identify the most common benefits and obstacles of utilitarian cycling. Initially reviewing the benefits for individuals and then communities. Secondly an analysis of infrastructural investments that try to make cycling safer and more viable in the urban centres. Thirdly a review of the main policies and programs used to try to stimulate and normalize cycling. Finally, based on the analysis of the literature, this chapter will identify the central impacts of cycling and the main strategies from the policies makers to make cycle friendly spaces in car-centric cities.

3.2. THE POSITIVE AND NEGATIVE IMPACT OF UTILITARIAN CYCLING

Over the last two decades, the number of policies and programmes have been increasing, aiming to raise the cycling levels in the urban centres. In the early 2000s, the focus of most policies was on the environmental aspects of cycling, due to the rising concern of climate change. Other common emerging approaches highlighted are the health benefits that cycling can provide, this strategy was aimed at individuals to embrace a healthier lifestyle. Since then, many studies have been developed to identify

and measure both positive and negative sides of cycling. The literature review, shows the main positive individual effects of everyday cycling are considered to be beneficial for the health, environment and the economy. The most common negatives are perceived as physical conditions such as weather and topography, or about the perception of fear, risk and danger.

The major positive impact of everyday cycling that has been identified is health. This benefit is due to the cycling can be a tool for to individuals increase their practice of physical activity. Over the past decade, it has become more evident that practising physical activity not only benefits the individual but the public health system too. The incorporation of physical activities in your lives can help reduce the risk of chronic diseases (Woodcock et al., 2009; Oja et al., 2011; Davis, 2014). Studies from Ma et al. (2021) showed that regular cyclists (cycling more the 3 days a week) have an inferior level of phycological distress and increase life satisfaction, and Forsyth & Oakes (2015) analysis shows that frequency cyclists had a lower Body Mass Index (BMI) and are more active.

The benefits of increased physical activity to an individual's health can generate positive repercussions for the public health system of the country (Oja et al., 2011; Davis, 2014). Research from (Lindsay et al., 2011) shows that in New Zealand, due to the increase of physical activities and the decrease of local air pollution cause by motorized vehicles there was a reduction of 5% in a year to the public health costs. Other individual benefits of cycling in cities are; the improvement of the wellbeing such as cognitive functions, and the reduction of the risk of depression, reduction of travel time, the increase of liveability of their environment and better quality of life (Götschi et al., 2016; Rajé & Saffrey, 2016).

Policy makers are realising the success that focusing on health as the main strategy to increase cycling levels is effective. Promoting day-to-day cycling is one of the most effective ways to raise physical activity in a major part of the population, for all age groups (Götschi et al., 2016). Nonetheless, studies have indicated that people less active and with poorly healthy condition are less likely to embrace cycling. However, the occasional cyclists (less than 3 days a week) are the most likely to embrace utilitarian cycling (Forsyth & Oakes, 2015; Ma et al., 2021). This shows why it is important for the policy makers to identify the target of their policies and programs, due policies focus on active cyclists, occasional cyclists and non-cyclists need to present different goals and strategies to succeed.

Another benefit of cycling is the reduction of environmental impacts caused by motor vehicles in cities. One of the main benefits identified from the increase of cycling as a transport mode is the decrease of air pollution, which leads to better health and economic benefits at an individual and community levels (Woodcock et al., 2009; Bopp et al., 2018). However, studies from (Rojas-Rueda et al., 2011), show bicycle sharing systems are mainly used by public transport goers, where carbon footprints are smaller per capita and seeing only 4% of car users frequenting the bicycle share system. Nonetheless, indirect benefits are coming from the reduction of the use of motorized vehicles for cycling such as; reduced air and noise pollution and the increase of social engagement by creating more liveable communities. (Götschi et al., 2016).

Studies have found a positive effect of cycling to work, both to the employee and the employer. It was found that the use of bicycles to commute decreased sickness absence and increased the productivity of the employee (Rajé & Saffrey, 2016; Bopp et al., 2018). The promotion of cycling through the employer with cycling facilities can stimulate more people to start using the bicycle, a common strategy used in England, providing both the employer and employee with economic incentives such as tax benefits. Furthermore, a study from Olsson et al. (2013) shows that people that walk or cycle to work are more satisfied with their commute journey.

Another positive result found with the increase of cycling levels is social benefits. It has been identified that 60% of frequently cyclist ride in their neighbourhood (Forsyth & Oakes, 2015) which can help to

improve social cohesion, community attachment and reduction of crime (Götschi et al., 2016; Bopp et al., 2018).

The combination of all these positive effects of utilitarian cycling can generate some significant economic impacts on an individual and community level. The most evident economic benefits are a direct consequence of the health benefits, due to the increase in physical activity. Possibly seconded by the environmental benefits for less emission of pollutants – that leads to better health (Davis, 2014; Bopp et al., 2018). Another economic motivation for policy makers to invest in cycling is due to the low cost and maintenance of cycling infrastructure, especially if compared with other transport modes (Rajé & Saffrey, 2016). Bicycling also has an economic impact on the local level because of the tendency of most cyclists to cycling in their neighbourhood. The limitation of short distances utilitarian trips highly influences the cyclist to explore more local shops and stores that can be more easily accessed by bike than a car (Rajé & Saffrey, 2016). On an individual level, the economic benefits are because there is no need to pay for fuel, insurance or other costs that come with the motor vehicle.

One of the most popular barriers associated with utilitarian cycling is the weather. There is a strong belief, especially among non-cyclists, that cycling is strongly affected by weather variation and climate. However, many studies have shown that the seasonal weather does not impact the commuting cycling levels as much as is believed (Nankervis, 1999; Médard de Chardon et al., 2017). There is a decrease during the winter period, and the levels start to increase during the spring, reaching the highest levels over the summer and autumn. Cities in warmer climates had a very low variation during the seasons, only places with temperate or continental climates are more affected.

The variation of temperature can affect the cyclist in many ways. Both hot and cold temperatures affect the cyclists and the cycling levels around the cities, but the effect of colder temperatures is stronger than in warmer temperatures (Nankervis, 1999; Nosal & Miranda-Moreno, 2014). Studies from Médard de Chardon et al. (2017) show that cyclists have their maximum performance in temperatures around 18º C to 33º C and Saneinejad et al. (2012) concluded that any temperatures below 15º C negatively affected the cycling levels. In England, the average temperature is 15.2 degrees Celsius with average highs of 24 and lows of 8 (MetOffice), presenting some challenges to cycling.

Other weather variations can affect commuting, such as rain, wind and humidity. Studies have shown that the increase of humidity and wind can negatively affect cycling levels (Nankervis, 1999; Saneinejad et al., 2012; Nosal & Miranda-Moreno, 2014; Médard de Chardon et al., 2017). The rain also can affect the cyclist, but the intensity of the impact can depend on the time of the day and the intensity of the precipitation. Studies from Nosal & Miranda-Moreno (2014) shows that rain in the morning has a stronger impact on the daily cycling levels than rain in other periods of the day. However, utilitarian and "regular" cyclists are less affected by this weather than other groups of cyclist (Nankervis, 1999; Nosal & Miranda-Moreno, 2014; Médard de Chardon et al., 2017).

Some other environmental aspects can influence people's decision not to adopt cycling, such as steep terrain. It has been reported that cyclists are not comfortable in inclinations between 4 and 8 per cent and tend to avoid any slope with more than 8 per cent (Midgley, 2011). Other factors can contribute, such as high density and vegetation on the streets (Ma et al., 2021)

As previously stated, the main obstacle that cycling faces in cities is fear. The majority of research shows that fear and the risk of road accident is one of the main obstacles that prevent non-cyclists from embracing the model shift. Götschi et al. (2016) highlighted in their research that the risk of crash and exposure to motorized traffic are the major negative size of cycling. Forsyth & Oakes (2015) analysis shows that the cyclists perceive most of the threats to be from moto vehicles, followed by uneven road surfaces and crime. There is the necessity of urban policies focus on the cyclist's needs that can promote

a safer urban environment, by providing the cyclist with the most direct, convenient and safe option so it can become a major urban transport (Fraser & Lock, 2011).

Safety might be considered one of the main problems of cycling, even though every city and person has different parameters of safe cycling and how this can be perceived can affect differently the levels of cycling in part of the city. Despite that, studies have shown that in cities with higher cycling levels the risk of road accidents reduces (Woodcock et al., 2009; Pucher et al., 2010; Pooley et al., 2013; Marshall & Ferenchak, 2019). The increase of cyclists on the street directly affects the increase of cycling safety, this happens mainly because there is the gain of visibility for the motor traffic and more respect for bicyclist rights. As mentioned, the risk of an accident will depend from place to place, and the best way to reduce is through the promotion of cycling and assure more security by reducing motorized traffic volumes and speeds. Furthermore, the risk decreases with segregation of the cyclists from the motorized traffic through infrastructure or bike routes on busy routes (Götschi et al., 2016)

The real impacts, positives and negatives, of embracing cycling will depend on the local context and on how the policies of promotion are implemented and embraced by the population. The main literature highlights that the benefits outweigh the risk (Lindsay et al., 2011; Johnson & Rissel, 2015; Rajé & Saffrey, 2016; Bopp et al., 2018). Health benefits are one of the most intensely advertised positive aspects of utilitarian cycling and over the past decade, it has been the main selling point for the policy makers (Fraser & Lock, 2011). The main obstacle of cycling has been shown by many pieces of literature, can be overcome with stronger investments in bicycle infrastructure and policies to prioritize cycling and make it the most direct, convenient and pleasant way to locomote in the urban environment (Woodcock et al., 2009; Johnson & Rissel, 2015).

3.3. PROMOTING CYCLING: MAIN INFRASTRUCTURE AND POLICES

There are two main ways of investment that can increase the cycling levels, the physical transformation of the space, where is built infrastructure that can make cycling safer and easier, and throughout campaign and promotion to increase cycling visibility in the urban environment. The main goal of the policy makers is to make cycling and walking easy and attractive, believing that if a major part of the population sees that way, they will change their behaviour (Pooley et al., 2013). Most of the studies point out that the best way to promote cycling is through a balance between infrastructural intervention and promotion and education (Pucher & Buehler, 2008; Pucher et al., 2010; Pooley et al., 2013; Aldred & Jungnickel, 2014).

The implementation of bicycle infrastructure, such as bike lanes, has become a very popular measure adopted by policymakers around the world to promote and create a safer environment for cyclists in urban life. There are many types of bicycle infrastructure with distinct functions and levels of complexity, and they can be characterized in two main categories: the travel-related infrastructure and the end-of-trip facilities. (McClintock, 2002; Pucher et al., 2010).

The most popular travel-related infrastructure is those that focus on separating the cyclist from the motor vehicle. This can be achieved by the implementation of bike lanes and paths in the city. The main difference between these two forms of intervention is that bike lanes consist of the delimitation of a street lane for bicycle users, that can be by delimitation cycling space on the road with white stripes, use of different pavements colouring or even be share with bus lanes (Pucher et al., 2010). The bike paths consist of a more isolated infrastructure, where there is a barrier separating the cyclist from the car, and it can be on the street or off-street paths, where it can sometimes be shared with pedestrians (Pucher et al., 2010; Wardlaw, 2014).

The travel-related infrastructure for more residential and less traffic zones are the signed bicycle routes and traffic calming (Pucher & Buehler, 2008; Pucher et al., 2010; Pooley et al., 2013). Designing and delimiting the main route for the cyclist using signs, not using any pavement differentiation or marks, can be a good solution for small and less busy streets. However, the most popular solution for less traffic zones is traffic calming measures. These interventions can variate from the implementation of physical obstacles to reducing the speed of the motor vehicle such as speed bumps, bulb-out and chicanes, to the delimitations of speed limits of 10 or 20 mph and home zones. Pucher et al. (2010) highlight in their research the positive impact of these interventions, in not only increasing the levels of cycling but also in increasing the sense of security and reducing the numbers of road accidents.

The end-of-trip facilities are focused on bicycle parking and station. The presence or absence of these infrastructures can be a determining factor for cyclists to choose to use the bicycle or another mode of transportation (McClintock, 2002; Pucher & Buehler, 2008; Pucher et al., 2010; Bopp et al., 2018; Cervero et al., 2019). The bike parking can variate by simple stand, for short-term staying, cover structures that provide weather protection, for more long-term staying, and bicycle centre and/or station, for more support and commodities to the cyclist, such as showers, locker rooms and bicycle maintenance and repair shops. It is important that to obtain better use of this infrastructure, the bike parking is in strategic spots around the cities, and the bike stations are near majors bus stops and/or train stations, and these services are integrated with the public transport system (Pucher et al., 2010).

A majority of the research (McClintock, 2002; Dill, 2009; Pucher et al., 2010; Pooley et al., 2013; Cervero et al., 2019) indicate that the bicycle network produces a positive result on cycling levels when there is quality, extensiveness and connectivity of a bicycle network. However, it is stressed that a bicycle network will help promote cycling if these provisions are the shortest path or the most direct route. The implementation of cycling infrastructure does not mean that cycling levels will increase but means that it can influence and contribute to behavioural change on a larger scale more effectively than other measures (Pucher & Buehler, 2008; Marshall & Ferenchak, 2019). Much of this infrastructure is to provide a safer environment for cyclists, which can slowly help increase cycling levels by helping decrease the road accident rates and promoting a safer and pleasant journey for them.

Another major way to promote cycling is through policies and programmes. They can vary from region to region, and the level of success or failure will depend on the local context. Each country has different policies and unique ways to execute and enforce them. The main literature was able to identify the most common policies and program use around Europe (Pucher & Buehler, 2008; Pucher et al., 2010). Major policies identify are integration with public transportation, training and education, promotion of events and indirect policies such as auto taxation, parking and land use.

One of the most popular policies highlighted by the literature is training and cycling education. These policies are appealing for the government because they are relatively low cost (Pucher & Buehler, 2008; Pucher et al., 2010). The cycling training programs can involve people of all ages and the main goal is to teach the population how to use the bicycle and have a basic knowledge of traffic laws. Training should be integrated for the drivers, as a way to make motor vehicle traffic more aware of cycling and know how to best behaviour when there is a cyclist on the road. This training will increase the levels of awareness of the population in the traffic and lead to a safer and more welcome environment for all cyclists and drivers (Pucher & Buehler, 2008). Besides that, these courses can help and teach cyclists to gain confidence and feel more secure while cycling, which can motivate a more vulnerable part of the population to cycle, such as children, the elderly and women.

Is important that policy makers use strategies such as the promotion of events. They can be helpful to stimulate interest and enthusiasm for cycling to a major part of the population, also help gain more

visibility to cycling (Pucher et al., 2010). The most common events are trip reduction programs, individualized marketing programs, and travel awareness programs, such as cycle-to-work days and safe routes to school.

Creating the link between cyclists and public transport is a fundamental key to consolidate the cycling culture. The integration with the public transport network can happen by providing end of trips facilities, such as bike parking near bus stops and train stations, or throw the implementation of bike racks in bus and trains, or the permission to carry the bicycle in the transport vehicle in off-peak times, limiting the amount allowed in each vehicle, or charging an extra fee (Bopp et al., 2018). The promotion of this policy can serve as a support for cyclists to complete their trip and helps them reach more distant locations. The bicycle can work as a missing link, as complementing the public transport network (Pucher & Buehler, 2008; Bopp et al., 2018; Holmgren & Ivehammar, 2019).

Some indirect policies can have an impact on the cycling level in a city. The main indirect policies used, especially in Europe are involving increasing taxes and fees for car ownership and petrol (Pucher & Buehler, 2008). The policies to discourage car use and reduce the attractiveness of motor vehicles are important strategies that can help increase the use of alternative transport, including the bicycle. The importance of these indirect policies, especially the one focusing on motor vehicles, is because car owners are less likely to be influenced to change their transport mode (Holmgren & Ivehammar, 2019).

Another important policy that has become more popular in the last few years is the implementation of Bike-Sharing Systems (BSS). They may be an attractive option for cities when the implementation is integrated with the local transport system (Midgley, 2011; Fishman et al., 2014). Besides, it is important, for the police to be successful, the presence of a bicycle infrastructure network to assure the safety of the users. In Rojas-Rueda et al. (2011) analysis of the BSS from Barcelona shown that was an increase of 30% of cycling trips, but only 1.7% uses the system daily. The major problem with these policies is that they may have trouble finding success because of local reliance on automobiles. Fishman et al. (2014) stress that is essential to implement policies that encourage the modal shift from the car and integrate the BSS with the public transport system to succeed in improving health and reducing air pollution.

3.4. CONCLUSION

This chapter seeks to identify and understand the major impact that utilitarian cycling can have on the individual and on the city, and how this effect can be used to promote and invest in cycling. As identified early, there is both positive and negative impact of cycling; table 1 and 2, highlight the main effect in the literature.

From this analysis, it is perceived that although there are barriers to embrace cycling, there are stronger and encouraging benefits that outweigh the negative impacts. As literature assured, most of the obstacles found can outgrow with the implementation of cycling infrastructure and policy to promote a more friendly and safer environment for cyclists. The effectiveness of cycling promotion will depend on the local context and culture, and how to engage the population and the government is to embrace cycling culture (Pucher et al., 2010; Aldred & Jungnickel, 2014). Pucher et al. (2010) highlight that the interventions will have different results in non-cyclists in cities with higher and lower levels of cycling.

Table 1 - Main benefits impact of utilitarian cycling.

Benefits	Findings	Main literature
Health	Reduction of chronicle diseases such as stroke, obesity, colon cancer, diabetes, osteoporosis and cardiovascular diseases.	Woodcock et al. (2009); Oja et al. (2011); Davis (2014)
	Reduction of psychological distress and the risk of depression.	Ma et al. (2021); Götschi et al. (2016)
	Increase in wellbeing, more life satisfaction and better liveability in their environment.	Götschi et al. (2016); Rajé & Saffrey (2016)
Environment	Reduce traffic problems such as air pollution and noise pollution.	Rojas-Rueda et al. (2011); Woodcock et al. (2009); Bopp et al. (2018)
	Decrease in car congestion.	Midgley (2009); Jones (2012); Davis (2014); Médard de Chardon et al. (2017)
Social	Increase social engagement and social cohesion, improve community attachment and contribute to crime reduction	Götschi et al. (2016); Leister et al. (2018)
Economic	Low cost and maintenance of cycling infrastructure, compared to other transport modes	Rajé & Saffrey (2016)
	Reduce the cost of the public health care system due to the increase in physical activity practice by the population.	Lindsay et al. (2011); Oja et al. (2011); Davis (2014); Leister et al. (2018)
	Increase the productivity in the work scenario and reduce sickness absence and more satisfaction on their commute journey	Rajé & Saffrey (2016); Bopp et al. (2018); Olsson et al. (2013)
	Economically support local shops and the develop neighbourhood economy.	Rajé & Saffrey (2016)

Another important lesson the literature emphasizes is the need for a comprehensive and coordinated implementation of measures to promote cycling. Policies that balance investments in the infrastructure and creation of programs and actions to promote cycling can generate a more positive impact on the cycling levels than policies that focus only on one strategy to promote cycling (Pucher & Buehler, 2008; Pucher et al., 2010; Pooley et al., 2013). With this integration, it is important that different departments, levels of government, and private organizations establish a good relationship and harmony to have a coordinated action plan.

In Pooley et al. (2013) research indicates that a more interventionist approach is necessary and not only focus on promoting active travel, but also say that is important to policies that reinforce cultural change. Pooley (2013) identify five main policy recommendations that, according to his research, are the most important to promote cycling. The recommendation is: the creation of a safe physical environment for pedestrian and cyclist, more campaign support and legislation for cyclist, a spatial adaptation of the city

for the small journey, have an accept cycling culture and the creation of an environment that normalization of cycling happens naturally and should be reinforced by advertising campaigns.

Table 2 - Main Negative impact of utilitarian cycling.

Obstacles	Findings	Authors
Weather	Colder temperatures (below 15°) can reduce the cyclist performance and negatively affect the cycling levels	Nankervis (1999); Saneinejad et al. (2012); Nosal & Miranda-Moreno (2014); Médard de Chardon et al. (2017)
	Wind and humidity can negatively impact the cycling levels.	Nankervis (1999); Saneinejad et al. (2012); Nosal & Miranda-Moreno (2014); Médard de Chardon et al. (2017)
	Rain can decrease the cycling levels, depending on the time of the day and the intensity.	Nosal & Miranda-Moreno (2014)
	Regular cyclists are less affected by weather variations.	Nankervis (1999); Nosal & Miranda-Moreno (2014); Médard de Chardon et al. (2017)
Terrain	Steep terrain, such as slopes with inclinations of more the 4%, tend to be avoided by a cyclist.	Midgley (2011)
	High street density and lack of vegetation can negatively affect cycling levels.	Ma et al. (2021)
Fear	The risk of road accidents and exposure to motorized traffic is one of the main obstacles identify for non-cyclist to embrace cycling.	Pucher et al. (2010); Forsyth & Oakes (2015); Götschi et al. (2016)

4
CYCLING POLICIES IN ENGLAND: A BRIEF OVERVIEW

4.1. INTRODUCTION

The use of the bicycle as a travel mode for short distances has become popular in Europe over the past decade. Countries such as the Netherlands, Sweden and Germany have one of the highest levels of utilitarian cycling and have been used as examples around the world for the implementation of their cycling culture. The cycling levels in the England are lower when compared with these countries. According to data from the 2011 census, only 2 % of the UK trips are made by bicycle (Department for Transport, 2013a). The British weather is used as a justification for the low cycling levels, but some countries, like Denmark, have similar weather to the UK and present higher cycle levels (McClintock, 2002). Another common obstacle is the fear of road accident, but, according to reports from the Department for Transport (DfT), the number of cyclists seriously injured or killed in the road have remains stable from the past four years, with a 4% decrease since 2015 (Department for Transport, 2020b).

The changes in the cycling levels are due to the increase in cycling strategies and goals in England transport policies. Most of the cycling policies in England are responsibilities of the DfT, providing guidance to local authorities and overseeing the implementation of the strategies. The DfT works at a national level and has the responsibility of creating initiatives and the local government is responsible for executing them. Charities and voluntary groups also have a significant role in helping the DfT and local authorities promote cycling. The main one is SUSTRANS, which provide formal and informal services, such as contributions for the planning process, providing maintenance workshops, etc. (Golbuff & Aldred, 2011) and is responsible for the provision and development of the UK National Cycle Network.

There is plenty of potentials for Britain to become a cycling nation; however, the investments in cycling remain low, particularly when compared with other European countries. Recreation cycling is one of the most common activities among adults in Britain, but there is a struggle to embrace utilitarian cycling at the same level. There is a potential to increase the cycle levels due to the high amount of small distance journeys, 38% of all trips are less the two miles and 66% are less than five miles, distances that can be easily made by bicycle (Department for Transport, 2013b). If the English cycle levels continue to grow in the speed is now, it would only reach the Dutch levels of 27% of trips, by the beginning of the 23rd century (Cycling UK, 2016).

With this potential in mind, this chapter will review the main English policies and programs from the past decade. First, we will highlight how these policies have been developed from the post-war scenario to the present days. Secondly, there will be a brief overview of the main policies developed in the past decades, where there was an intensification of policies focused on promoting cycling and walking as more sustainable means of transport. We aim to understand the effectiveness of these initial policies and how it helps shape the scenario for more recent interventions.

4.2. THE FALSE START

The post-war period was marked by a strong transport policy focusing on road building and encouragement of car ownership, transforming cycling into a more residual form of transportation in the English towns and cities (Golbuff & Aldred, 2011; Jones, 2012). With policies focusing on automobiles, the urban environment starts to be designed to prioritize motorized zones which led to physical segregation of pedestrian and cyclist. Most of the post-war 'New Towns' were developed with a car-dominated design. However, there was an attempt to increase cycling levels in some towns, such as Harlow and Stevenage, where a segregate provision was built for cyclists, and Milton Keynes, that posterior, added a cycle and pedestrian network (Aldred, 2012; Jones, 2008 apud; McClintock, 2002).

At the beginning of 1970, there was an increase in cycling but an exceptionally low level. This increase was continually ignored by the government which continued to pursue policies focusing on road building and increasing car ownership (Wardlaw, 2014). At this period, there is the formation of many pressure groups and political activism due to the environmental problems caused by using fossil fuel. With the oil crisis in 1973 in the Middle East, it became clear the need to decrease car dependence and stimulate the use of no-motorized transport (Golbuff & Aldred, 2011).

In 1977, the Labour Government introduced the Transport White Paper declared a clear concert with the government with high oil prices and the need to promote other means of transport that were not dependent on fuel. With the rise of the pressure of the environmental and transportation organizations, the government initiate 'Innovation Cycling Projects' giving local authorities budget to create practical initiatives to stimulate walking and cycling. Due to the cost of investment in creating segregate cycling routes, most of the interventions were focused on practical initiatives. (McClintock, 2002; Golbuff & Aldred, 2011; Aldred, 2012). Most of the interest in improving the cycling conditions came from the local authorities. There was not an effective action coming from the national government to improve or use the supplementary funds for cycling initiatives.

Throughout 1980, cycling became more popular, but cyclists are still too vulnerable to traffic. There was an increase in the visibility of cycling by the policy makers, but they continued to be unseen and unprotected from motor vehicles (Aldred, 2012). To contribute to the marginalization of cycling, by the end of the decade, there was a strong car policy implemented by Margaret Thatcher, who describes the period as the 'great car economy' (Golbuff & Aldred, 2011). During the period, bicycle levels declined significantly, also with the public transport system due to the increase in car ownership. By the end of the decade, the cycling levels in England had dropped considerably, leaving the country far behind the cycling level of Northern European countries (Aldred, 2012).

4.3. THE BEGINNING OF PROMOTING CYCLING

By 1990, cycling levels had been declining for a decade, making clear the need for new transportation policies. With this, there was the emergence of a new UK transport policy, the 'New Realism', that aimed to decrease car travel demand and to promote a modal shift (Aldred & Jungnickel, 2014). In this decade, started the implementation of more sustainable development strategies in the UK, after the Earth Summit in Rio de Janeiro in 1992. Was at this point that became clear the need to reduce car dependence (McClintock, 2002). For this change, the government needed to change its strategies from advertising the risk of biking to promote their major advantages and benefits (Aldred, 2012).

Even though in this period the concern about investing in cycling increased, the development of policy evolved slowly. Guidance and funding were insufficient from the national government to the local authorities (Golbuff & Aldred, 2011). The lack of national support caused a non-prioritizing investment

in national cycling infrastructure (Aldred, 2012). Until this point, there was no exclusive and strong cycling police in place or any integrated transport police. It was only in the second half of 1990 there was the start of the cycling policies with the emergence of the National Cycling Strategy (NCS), The National Cycle Network (NCN), and the implementation of the new Local Transport Plans (LTP).

The National Cycling Strategy (NCS) was launched in 1996. This strategy was the first time the Government established a concrete objective to increase cycling levels, marking a break in UK transport thinking. (Golbuff & Aldred, 2011). The main target of the program was to 'double the number of trips by cycling by the end of 2002 and quadruple by the end of 2012'. Even though the program was well spread across the country, there was a critical reception of it due to the high ambition, and considering the UK standards and levels of cycling, the success of the strategy was doubted (Golbuff & Aldred, 2011). Due to unrealistic targets, the program did not have support from the local authorities or considerable funding so was abandoned by the next government (Wardlaw, 2014).

One of the first major programs launched by this new agenda was the National Cycle Network (NCN) in 1995. This project started when SUSTRAN, UK sustainable transport charity, won a National Lottery grant of £42.5 million from the Millennium Commission. The primary objective of the investment was the establishment of a national network that facilitates walking and biking (SUSTRAN). The focus was building the network of quiet lanes, which prioritize low traffic, such as walking and cycling, in old and deactivated railway lines and along river corridors.

The original goal was the development of 5,000 miles that was accomplished in 2000 and, five years later, more than 10,000 miles were built (Jones, 2012). So far, the NCN has over 16,000 miles across the UK, with on-roads and off-road infrastructures. The expansion of the network is due to the collaboration of local planning authorities, local landowners from the private and public sector, local heritage groups and many other community groups (Aldred, 2012). Maintaining the networks is through collaboration from SUSTRAN, voluntary work and an alliance with landowners responsible for taking care of designation sections of the network.

Creating the network had many impacts on the local cycling and walking levels. According to reports from the SUSTRANS, 56% of all journeys have a utilitarian purpose and 44% was for leisure. In 2017, the network was used for 377 million cyclists, making 23,300 cycling trips per mile. Many local benefits have been identified with the growth of the network, such as the reduction of traffic, local economic benefits and increasing health. The network adds each year, to the UK economy, £88 million with the reduction of congestion and inject £2.5 billion to local economies due the leisure and tourism uses (SUSTRAN).

The new Local Transport Plan (LTP) was implemented after the publication of the Integrate White Paper in 1998, where it recognizes the shift of policy making in England, with the increase of funding for cycling, walking and public transport (McClintock, 2002). The LTP became the new system for local transport funding for five years, where the old policy was a yearly Transport Policies and Programmes (TPP). With this new policy, the local authorities were forced to establish a five-year transport strategy along with the funds necessary for the delivery. Also, the LTP requires all local authorities (except London) to include a cycling strategy. The main idea behind this new strategy was to provide long-term thinking for the transport policies at a local level (Golbuff & Aldred, 2011). The first LTP executed was from 2001 to 2006. The establishment of this plan marks the start of the promotion of cycling in the government's scenario. However, this program and policies were unlikely to be successful from the start due to the main transport policy continuing to be motor dominant (Aldred, 2012). These policies were designed to promote and raise cycling levels but did not motivate the decline in the use of motor vehicles.

Even there was a lack of success in increasing cycling by the end of 1990, these attempts mark the start of the cycling policies and promotion in Britain transport planning.

4.4. FROM THE 2000S UNTIL NOW

With the turn of the century, more policies and programs were implemented in Britain's towns and cities. Even with the increase of some measures and infrastructures, there was still a lack of engagement of the population to make the transport shift. To change this statistic, the government has been developing and implementing for the past twenty years programs and policies that aim to change the transport scenario in the country.

The start of this new era of cycling promotion was with the launch of Cycling England in 2005. This program consisted of an independent board composed of members from the DfT, department experts and specialist in transport planning and with the support of cross-sectional government groups and departments, such as transport, health, education and skills, environment, culture, food and rural affairs and media and sport (Golbuff & Aldred, 2011). This program came as a replacement from the National Cycling Strategy board that was assembled with the NCS. The focus of this was the creation of support packages for local authorities to guide them in promoting local cycling (CyclingEngland). There was an initial budget of £5 million that increase to £140 million due to contributions from the Department of Health (Golbuff & Aldred, 2011). The program ran until 2011 when it was abolished, showing the government hesitation to embrace cycling.

The most popular program introduced by Cycling England was the Cycle Demonstration Towns from 2005 to 2011. Was determined six towns would receive a total fund from Cycling England of near £17 million that would be shared between the towns to implement programs to promote cycling (CyclingEngland). The towns chosen were Darlington, Lancaster, Exeter, Aylesbury, Derby and Brighton and Hove. This program allowed an investment of £10 per habitants per year in cycling promotion and infrastructure, against the £1 average of the country (Aldred, 2012). The main goal was to implement programs and a comprehensive set of measures to promote cycling for short distance journeys, that can be shaped into the local context and cycle goals. After five and a half years of the program was found there was a rise of the cycling levels of 29% in the selected towns (Sloman et al., 2017).

Due to the success of the first six towns, in 2008 was implement a new Cycle Demonstration Towns and Cycling City, with the inclusion of more than eleven towns and one city: Blackpool, Cambridge, Chester, Colchester, Leighton/Linslade, Shrewsbury, Southern-on-Sea, Southport with Ainsdale, Stoke-on-Trent, Woking and York and the first city with Bristol. The initial six towns were included in the program, and the main goal continued the same as in the first program. There was an overall increase of the cycling levels of 24% for all the 12 new towns and cities in three years of the program (Sloman et al., 2017).

With the end of the Cycle Towns and City in 2011 and with the extinction of Cycling England in the same period, the only other main national wise cycling promotion scheme was launched by the DfT in 2013, with the Cycle City Ambition (CCA) Program. The primary aim was to provide a long-term strategic view of cycling in eight participant cities: Birmingham, Bristol, Cambridge, Leeds, Greater Manchester, Newcastle upon Tyne, Norwich and Oxford (Department for Transport, 2015). The program consisted of the execution of 14 schemes between the participant's cities, where the focus was improvements on cycling infrastructure, creating and maintenance of cycle routes, cycle bridges, redesign major's junctions and crossing and cycling facilities. The program ended in 2018 and it had a

total fund of £191 million that was shared between the cities (Sloman et al., 2019). Like the previous program to promote cycling, one of the goals from it was to increase the investments in cyclin to over £10 per cyclist. According to recent reports, there was an increase of the cycling volumes in participants cities of around 12% to 69%, however, the final evaluation of the success of the program has still been developed (Sloman et al., 2019).

Even though all these major programs had mainly positive impacts, the main complaint is that they had specific towns and cities and did not encourage cycling on a national scale. However, two programs embraced cycle promotion more inclusively, the Bikeability and Cycle to Work Scheme. The first one was launched in 2007 and constitutes a government national cycle training program managed by the Bikeability Trust and implemented with the collaboration of local authorities (Department for Transport, 2020a). The main goal of the program is to teach the fundaments of safe and responsible cycling focusing on the younger population. The main impact is the increase in the confidence and skills of children to ride on the roads and the trust of parents to allow their child to cycle more (Department for Transport, 2019a).

The Cycle to Work Scheme was implemented in 1999 to attract more people to cycle. The program is designed to promote benefits for employers and employees who join the program. The main concept behind the scheme is a tax saving throughout the 'salary sacrifice' where it can be saved 25 to 35% of the cost of acquiring a bike and/or cycling accessory. There are over 40,000 employers who joined the scheme and helped more than 1.6 million commuters cycle to work (Department for Transport, 2019b).

The other major action taken by the government was the implementation of the Cycling and Walking Investment Strategy (CWIS) in 2017. The strategy focuses on making cycling and walking the natural choice for short trips or part of the long journey, by 2040 (Department for Transport, 2020b). The main objectives are set for three periods. By 2020, the primary goal to be met is: increase walking and cycling activity, reduce the number of cyclists killed or seriously injured in traffic and increase the percentage of children who walk to school. In 2025, the goal is to double cycle, increase walking activity, and increase the percentage of children who normally walk or cycle to school. Lastly, by 2040 the strategy should be able to provide safer streets to cycle, more cycle training, more integrated communities, more quality cycling facilities and infrastructure, a more connected network and street more inclusive (Department for Transport, 2017). This investment strategy is linked to other policies and strategies, that can help then been delivered, like Clean Growth Strategy, Future Mobility: Urban Strategy, Clean Air Strategy, Sport England Strategy: Towards an Active Nation, Childhood Obesity Plan Chapter 1 & 2 and Prevention is Better Than Cure Approach (Department for Transport, 2020b).

However, the main strategy approached by the CWIS is to develop the Local Cycling and Walking Infrastructure Plans (LCWIPs). These plans come as a government attempt to develop long-term proposals to develop local cycling and walking networks. The LCWIP are structured to cover a ten-year period and be implemented with the collaboration of the Local Authorities. The main goals to be achieved by the LCWIP, are the development of a cycling and walking network plan that highlight main routes, focus on infrastructure programmes as a future investment and identify and report the main impacts and improvements of the program (Department for Transport, 2017). The plan is not mandatory, but so far, the CWIS has helped 46 local authorities elaborate their LWCIP, and 33 plans have been completed. It is important to obtain the goal that the plan is updated and renewed every four or five years and that it is well integrated with other local plans and policies, such as the LTP.

In the past year, the government released a new plan due to the impact of travels on the pandemic of COVID-19. The Gear to Change is a bold vision from the central government to consolidate active travel, such as cycling and walking, as a transport mode. The plan is divided into four approaches:

- Better streets for cycling and people.
- Cycling and walking at the heart of decision-making.
- Empowering and encouraging local authorities.
- Enable people to cycle and protect them when they do.

The most notorious and bold determination of this new plan is the investment of £2 billion to promote cycling and walking. This is the biggest investment that the government has ever announced, and the value represents an increase of six times from the previous cycling and walking fund. Besides that, the main aim of the plan is to invest in as many miles of cycle routes, making them as connected and direct as possible and segregating from pedestrian and high traffic volumes. On this plan, it defines for the first time that the cyclist should be perceived as a vehicle, so no more investments in sharing infrastructure with the pedestrian.

There has been much change in the policies and programs made in Britain in the past decades. There are many investments developed, but many of them end up not presenting high success rates, of just the impact cannot hold over the end of the programs. Much of this is attributed to the government's still emphasis on auto and motor thinking policies. But with the impacts of the pandemic and the new plan released in 2020 may be a change that the country needed to fully embrace cycling as a transport mode.

4.5. CONCLUSION

The cycling promotion in Britain is going through a lot of changes and improvements. Taking as a comparison to other European countries, the promotion of cycling in English towns and cities occurred later and is less efficient. There was an initial reluctance to implement policies and strategies to promote cycling, and the first attempt to change the scenario did not embrace cycling as a transport mode.

For the first 40 years, there were few policies to promote cycling. Most of the policies were still car-centric and the government was reluctant to invest in stronger policies and cycling infrastructures. Only by the end of 1990, a new approach in the promotion of cycling in the UK began, however, even with the increase of policies, many barriers to cycling investments can be found.

Many authors say that the main challenge with the promotion of cycling in the UK is due to the lack of commitment for the policy planes to not only create policies promoting cycling but also incentive the reduction of car uses. Aldred et al. (2019) highlight that the main problems are low resource and strong political support to car dependence. Is necessary, to break the vicious cycle that cycling policies face in England that is the lack of money to promote cycling that leads to poor facilities, which decrease the cycling and marginalizing this transport mode, which will be seen as a political risk so no government will investment.

5 ANALYSIS

5.1. INTRODUCTION

The analysis will focus on how factors such as policies and programs, infrastructure and topography can affect the cycling levels, specifically between 2011 and 2019. Identifying the major's differences and similarities between select towns and cities and how they affect the local cycling levels.

This chapter will also identify how these factors can influence the national and local cycling levels in England. In the first section of this chapter, the methodology is described, of how data was gathered and the process for the analysis. The methodology will also describe the criteria for the towns and cities selected to produce a representative sample. Firstly, the national cycling levels will be interrogated followed by the local. Lastly, a cross analysis of all information gathered will be presented to formulate an understanding of how each factor affects another. This will identify how cycling levels in English towns and cities are influenced by local and regional policies against physical elements such as cycling infrastructure and topography.

5.2. METHODOLOGY

This study consists of an analysis of data from; DfT, Department of National Statistics, Department of Transport Statistics and City Council websites. The main documents obtained are reports and tables from the UK 2011 census and the National Travel Survey of 2019 focusing on the Walking and Cycling Statistics, providing both national and local statistics. Other local and individual data were obtained on city council websites for each town and city analysed. Local Transport Plans (LTP), Transport Plans, Local Cycling and Walking Infrastructure Plan (LWCIP), Cycling strategies, Environment Strategies and Wellbeing and Health Strategies have been analysed as further sources of information to determine how policy makers can influence cycling levels.

The towns and cities analysed are from all regions from England, excluding the Greater London region. Focusing on small cities and large towns provides a larger sample pool and the reality of the Great London region is that it is vastly different from other regions due to its 8 million population and infrastructure investment levels.

Five main factors will be considered in the analysis: national statistics, cycling levels, policies and programs, cycle infrastructure and topography. Data will be gathered from the selected cities and towns for each of the factors and later used for cross analysis. This will result in how these factors affect the cycling levels on a local and national scale.

The analysis aims to investigate cities with different history's, economies, which have similar sizes and population. The data collation is composed of an individual analysis of each city and town chosen. This individual approach will investigate the main policies and programs that can be found on a local or regional scale, the main infrastructure presented and the terrain of each town and city. Furthermore, it

will highlight any national programs that affect the local area. The goal is to identify the main impact of these factors on cycling levels.

5.2.1. TOWNS AND CITIES SELECTED

Two cities or towns from each region have been selected, where one presented lower and the other higher levels of cycling. Another factor that was taken into consideration in the selection was the participation in any major national cycling programs as mentioned before, giving priority to choose city or town that has been involved to give a greater source of data.

The cities and towns are spread across England and present very diverse cycling levels. In the image 6 we can see the locations in England of each selected city and the cycle levels according to the cycle to work levels from the 2011 UK census.

England Regions:

- North West
- North East
- Yorkshire and the Humber
- East Midlands
- West Midlands
- East of England
- South East
- South West

Towns and Cities	Cycle to work (2011 UK census)
1- NewCastle Upon Tyne	1,1
2- Sunderland	0,6
3- York	4,4
4- Leeds	0,8
5- Liverpool	0,8
6- Manchester	1,6
7- Chesterfield	0,5
8- Derby	1,7
9- Birmingham	0,6
10- Worcester	2,0
11- Cambridge	12
12- Oxford	7,2
13- Bristol	3,5
15- Southend-on-Sea	1,1
14- Woking	1,2
16- Plymouth	1,2

Figure 6 – Map with the select towns and cities with 2011 cycle levels. Adapt from Google Maps, 20/05/2021, and data from Department for Transport 05/11/2020 (https://www.gov.uk/government/statistical-data-sets/cw090-cycling-to-work-at-local-authority-level)

5.3. ANALYSIS

5.3.1. NATIONAL STATISTICS AND TRENDS

As mentioned before, the cycling levels in England are considered low, especially when compared to other European's countries. The average spend by local authorities in cycling is around £6 per person in

2018/19, a budget that is half of the one that applies in the Great London (Department for Transport, 2020b). The main transport mode in England remains the car, with a dominance of 59% of all trips and cycling representing only 2% of trips. The most common cycling purpose in 2019 was for leisure (26%), followed by shopping trips (19%) and commuting (15%). These proportions have been broadly unchanged since 2002, but the total amount of trips and total distance travelled has decreased between 2002 and 2018.

The demographic analysis of cyclists in England shows that two main age groups cycle more for utilitarian purposes, from 16 to 24 and from 35 to 44. The group after 60 years old is the one that least cycles. With that we can see that utilitarian cycling is more embraced by a younger population, however, when we look at recreation there is more balance engagement from the population from 16 to 54. When analysing jobs and occupation the demographic that cycled most was the student population with 11.5%, followed by workers with a professional qualification representing 7.3%. The major ethnicity of cyclists identified as white British/Others and Chinese, but cycling still present in other groups, such as mixed ethnicities.

However, the most discrepant data concerning the demographics is the disparity of cycle levels between gender. DfT data from 2019 shows a major difference of cycling levels between men and women. Where a man does around 24 trips by bicycle per year, women only do 8, showing women cyclists are considerably less than men. By 2019, the average miles per man was 86, when on women was only 23 miles, less than half of men. Since 2011 this difference has been noticed and little has changed the difference between them, as it can be seen in figure 7. An English man, in 2019 tends to cycle 2.5 more than a woman and for almost four times the distance.

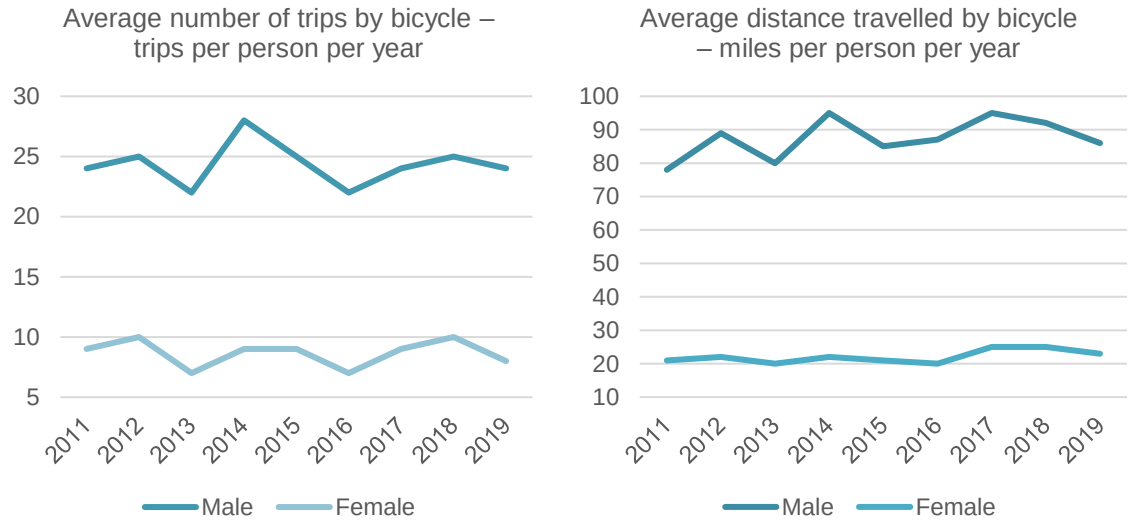

Figure 7 – Graphics with the average number of trips and distance travel by gender. Source DfT, 2019, (https://www.gov.uk/government/collections/walking-and-cycling-statistics).

One of the main reasons for such considerable difference in the data for gender is due to the perception of fear and risk of cycling. According to the survey From the Department for Transport Statistics, 71% of the women find cycling on the road dangerous, against the 61% of men. In the general population, 66% of the participants identify cycling as risky and dangerous. The perception of danger is even higher

when you compare non-cyclist with a cyclist, in the first group, 70% of them see cycling as dangerous against 57% of the second group.

To study the national, regional and local cycling levels was use as base for this analysis the cycle to work levels from the 2011 census and the data from the walking and cycling statistics where was retrieve the levels for the people that cycle for utilitarian purpose at least five times per week from 2012/13 to 2018/19.

When analysed the cycling levels on a national scale we can see that the levels from England in 2019 was 1.8 against the 1.3 presented in 2011. The region with the highest level of cycling is the South (west and east) along with the East of England and the lowest are North East and West Midlands. The table 3 shows us the variance of the cycling levels in these regions, from 2011 to 2019. We can see that most of the regions presented constant growth and there were no major variations in the cycling levels. Although there is a considerable difference in the cycling levels between the cycle levels found in the northern regions from the southern.

Table 3 – Cycle Levels per region from 2011 to 2019.
Source DfT, 2019, (https://www.gov.uk/government/collections/walking-and-cycling-statistics)

Region	2011	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
England	1,3	1,5	1,6	1,5	2,1	2,0	2,0	1,9
North East	0,7	0,8	1,0	0,5	1,2	1,3	1,2	1,0
North West	0,9	0,8	1,0	1,3	1,4	1,7	1,5	1,4
Yorkshire and the Humber	1	1,1	1,2	1,1	1,7	1,4	1,6	1,3
East Midlands	1,2	1,4	1,3	1,3	1,7	1,7	1,5	1,6
West Midlands	0,9	1,2	0,8	1	1,4	1,3	1,2	1,1
East England	1,5	2,0	2,2	2,2	2,7	2,5	2,4	2,2
South East	1,3	1,6	1,8	1,6	2,3	2,1	2,2	2,2
South West	1,5	1,3	1,8	1,5	2,1	2,3	2,1	2,2

To comprehend the change of the cycling levels in the regions we can see the table 4, where there is a comparison of the lowest and higher cycle levels from 2011 and 2019. This side-by-side data shows that in all the regions present growth, there was not a drastic increase between the two years except the South East. The top four regions did not change, however, Yorkshire and the Humber showed great levels of growth but started to decline after 2015 but remained higher than in 2011.

Table 4 – Regions with lowest and highest cycling levels from 2011 and 2019.

	2011		2019	
	Region	**Cycle level**	**Region**	**Cycle level**
Lowest cycle level	North East	0,7	North West	1,0
	North West	0,9	Yorkshire and the Humber	1,3
	West Midlands	0,9	West Midlands	1,1
Highest cycle level	South West	1,5	South West	2,2
	East England	1,5	East England	2,2
	South East	1,3	South East	2,2

To understand how the cycling levels changed from 2011 to 2019 the growth rate of each region and England was determined by using the formula:

$$PR = \frac{(V_{Present} - V_{Past})}{V_{Past}} \times 100$$ Where:

PR= Percent Rate

$V_{Present}$= Present Value

V_{Past}= Past Value

All the regions presented positive growth, including England itself. The region with the most significant growth was the South East, with 69% growth in the cycle level from 2011 to 2019. When compared the cycling levels with the growth rate we can notice that by 2019 the regions with the lower cycle levels were North East (1.0), West Midlands (1,1), Yorkshire and the Humber (1,3) and North West (1,4) and the regions with the lowest growth rate were West Midlands (22%), Yorkshire and the Humber (30%), East Midlands (33%) and North East (43%). The main difference is that the North East presents the lowest cycle levels but was not the region with the lowest growth rate, it was the West Midland. For the highest cycle level, it is evident that the three regions present the same value of 2.2 but they show different growth rates, but still all higher than the national rate.

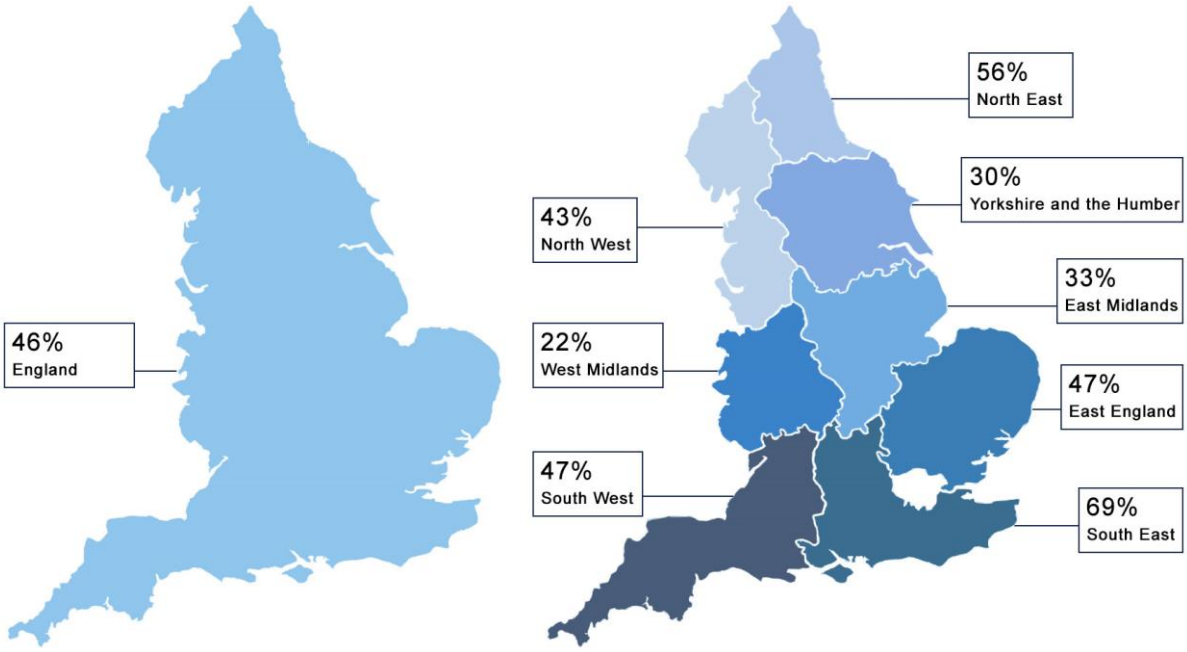

Figure 8 – Map with national and regional levels of growth from 2011 to 2019.

The main analysis of the national aspects is the cycle, in England, continues as a not popular transport model choice. There is a lot of disparities between the population that embraces cycling, as can be noticed, there is a tendency to be higher with a specific group, such as white male students. There is a lot of fear and resistance from the population to switch to cycling, that is one of the main reasons why cycling levels in England and all the regions did not obtain a high growth rate over the years.

Also, there is a lack of harmony on the cycle levels with the regions, where the South Regions and the East of England presented not only better cycle rates, but also most growth, where the Midlands, the North and Yorkshire continue with extremely low levels of cycling.

5.3.2. CYCLING LEVELS

One of the factors that will be taken as based is the analysis of the cycling levels in each town and city using as base data from the Department for Transport and National Statistics. The main object of this is to understand how everyday cycling has changed in the past ten years in each city, what are the cities that presented a major growth in cycling levels and the ones that decrease their levels. Table 5 detail the cycling levels in each city and town for the past decade.

Table 5 – Cycling levels of major towns and cities from 2011 to 2019.
Source DfT, 2019, (https://www.gov.uk/government/collections/walking-and-cycling-statistics)

Town/City	2011	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
England	**1,3**	**1,5**	**1,6**	**1,5**	**2,1**	**2,0**	**2,0**	**1,9**
North East	**0,7**	**0,8**	**1,0**	**0,5**	**1,2**	**1,3**	**1,2**	**1,0**
Sunderland	0,6	0,6	0,4	0,1	0,4	0,4	2,6	0,8
Newcastle upon Tyne	1,1	1,5	2,7	1,8	1,2	2,5	2,1	3,2
North West	**0,9**	**0,8**	**1,0**	**1,3**	**1,4**	**1,7**	**1,5**	**1,4**
Liverpool	0,8	1,1	0,4	4,8	1,6	1,3	3	2
Manchester	1,6	0,7	2,1	1,2	2,6	4,3	3,3	4,1
Yorkshire and the Humber	**1**	**1,1**	**1,2**	**1,1**	**1,7**	**1,4**	**1,6**	**1,3**
Leeds	0,8	0,7	1,1	0,8	1,2	1,3	2,2	1,3
York	4,4	7,1	7,3	6,2	8,9	6,8	4	7,4
East Midlands	**1,2**	**1,4**	**1,3**	**1,3**	**1,7**	**1,7**	**1,5**	**1,6**
Chesterfield	0,5	0,3	0,1	0	0,8	1,4	0,2	0,5
Derby	1,7	1,2	1,8	1,7	1,7	1	2,5	2,3
West Midlands	**0,9**	**1,2**	**0,8**	**1**	**1,4**	**1,3**	**1,2**	**1,1**
Birmingham	0,6	0,9	0,2	1,2	1,8	1,3	2,1	1
Worcester	2,0	1,2	0,3	4,1	1,3	4,7	1,2	1,2
East England	**1,5**	**2,0**	**2,2**	**2,2**	**2,7**	**2,5**	**2,4**	**2,2**
Southern-on-Sea	1,1	1,4	1,1	1,7	3,1	1,1	1,4	3
Cambridge	12	18,6	24,1	24,6	26,8	24,1	26,2	25
South East	**1,3**	**1,6**	**1,8**	**1,6**	**2,3**	**2,1**	**2,2**	**2,2**
Woking	1,2	0,4	4,3	3,5	2,3	1,5	1,4	4,1
Oxford	7,2	10,4	9,5	9,8	17,6	15	16,8	16,4
South West	**1,5**	**1,3**	**1,8**	**1,5**	**2,1**	**2,3**	**2,1**	**2,2**
Plymouth	1,2	0,4	0,8	0	1,5	1,4	1,4	2,1
Bristol	3,5	2,3	2,8	3,8	6,9	5,6	6,7	5,7

Only two cities did not present any cycle levels: Chesterfield and Plymouth, both in the same year of 2014/15. However, since then, the cycle levels for Plymouth have managed to keep growing for the last four years, and even Chesterfield manages to increase the levels of two years, but it ends up decreasing. When compared to the national level we can see a balance, half of the city or towns with cycle rates lower than the national level and the other half higher in 2011. However, in 2019, only five towns and cities were with cycle levels lower than the national rates.

Table 6 is a comparison of the five towns/city with lower and higher cycle levels in 2011 and 2019. This analysis shows us that even within eight years there was not much alteration on the list. Chesterfield continued with the lowest cycling levels and did not present any increase, although all the other cities and towns that were previously in the lowest levels, such as Sunderland, Birmingham and Leeds presented an increase in their cycling levels. The cities and towns with the highest cycling levels almost stayed the same except for Worcester.

Table 6 – Cities and towns with lowest and highest cycling levels of 2011 and 2019.

	City/Town	**2011 Cycle level**	**City/Town**	**2019 Cycle level**
Lowest cycling level	Chesterfield	0,5	Chesterfield	0,5
	Sunderland	0,6	Sunderland	0,8
	Birmingham	0,6	Birmingham	1
	Liverpool	0,8	Worcester	1,2
	Leeds	0,8	Leeds	1,3
Highest cycle level	Cambridge	12	Cambridge	25
	Oxford	7,2	Oxford	16,4
	York	4,4	York	7,4
	Bristol	3,5	Bristol	5,7
	Worcester	2	Woking	4,1

Most of the cities presented a constant and low level of growth in cycling levels from 2011 to 2019, except for Worcester, which presented a decrease of 40% in cycling levels. Most of the growth rate maintained below 100% and the place with the highest growth rate was Woking with an increase of 242%. Cities such as New Castle Upon Tyne, Southern-on-Sea, Manchester, Liverpool, Cambridge and Oxford also present a considerable growth rate with all presenting values more than twice as high as in 2011. The cities with the highest cycling levels such as Cambridge and Oxford did not present the highest growth rates and the city with the lowest cycling levels did not present any growth. This was possibly due to the lack of infrastructure investment during this period.

The map does not show any distinct pattern between regions of the increase in cycling levels from a national perspective. Despite cycling levels in the northern regions generally being low 3 out of 7 of these cities have experienced a high level of growth since 2011.

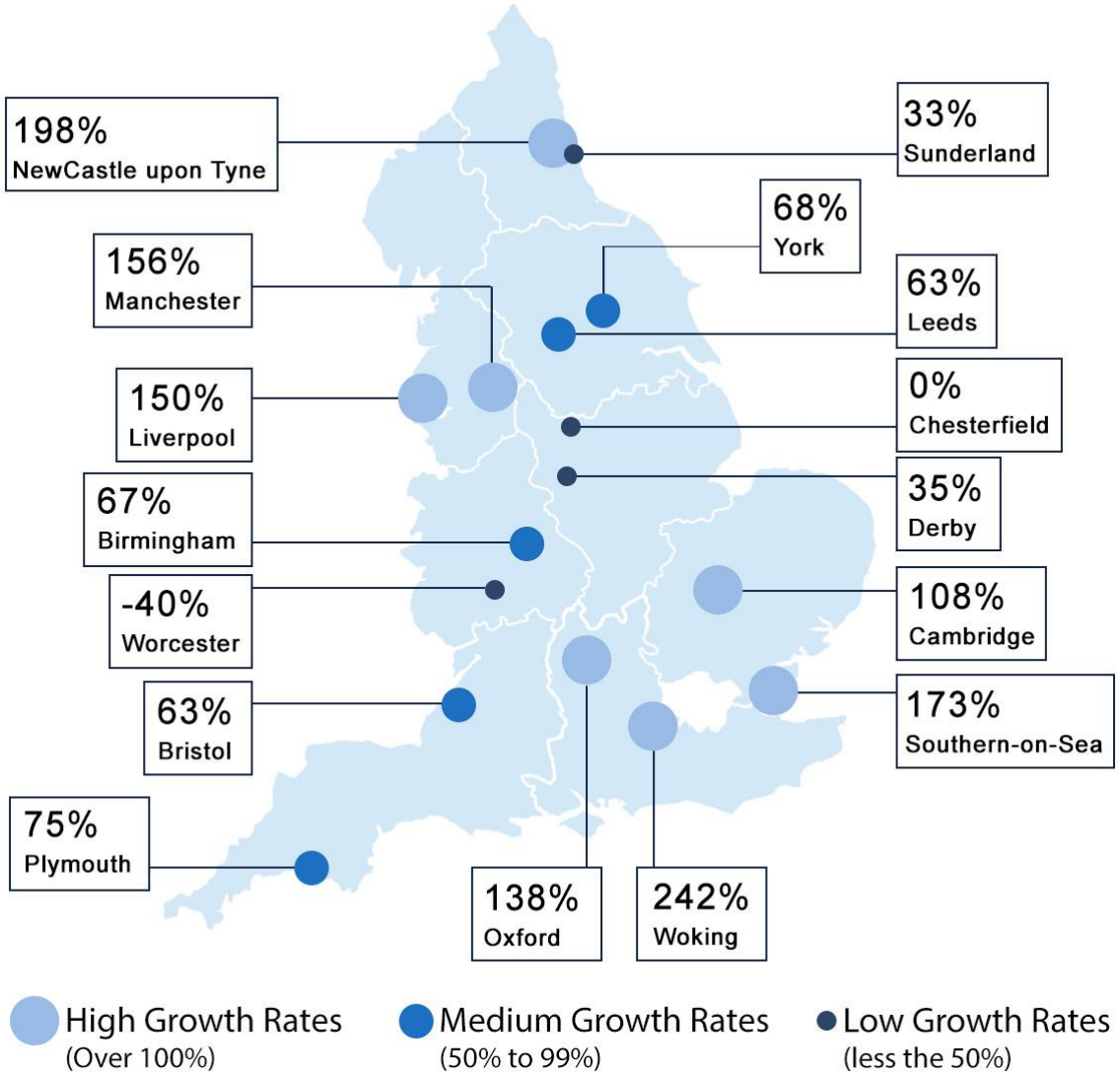

Figure 9 – Map of cities and towns levels of growth

5.3.3. POLICIES AND PROGRAMS

The data for this section was gathered from city/towns council websites, aiming to find the main policies in place that directly and indirectly promote cycling. These policies can be seen below in table 7 and include transport, environmental and health policies and programs.

As mentioned in chapter four, every city LTP is required to specifically address the promotion of cycling. Some cities, such as Sunderland, Chesterfield, Woking, Plymouth and Bristol presented a Joint Local Transport Plan, where the policy was developed with the collaboration of other local authorities or counties.

The implementation of the Local Cycling and Walking Infrastructure Plan (LCWIP) that was launched by the CWS in 2017 has only started to be implemented over the past two years, so only a few cities finished the development and implemented the policies. Only Liverpool, Leeds, Birmingham, Woking, Oxford and Bristol have their strategy developed and just implemented the policy. Places such as Sunderland and Newcastle are still developing on their own.

Table 7 – Main policies and plans in each town and city.

Town/ City	Transport/Mobility	Environmental	Health/Wellbeing
Sunderland	Join LTP3 (2011-2021) LCWIP (in development)	Carbon Plan 2017-2020 Air Quality Action Plan Low Carbon Action Plan 2020	Active Sunderland Sunderland Healthy City Plan 2020-2030
Newcastle upon Tyne	LTP3 LCWIP (in development) North East Transport Plan 2021-2035 Delivering cycling improvements: a ten-year strategy (2011-2022)	Air Quality Action Plan	Active Newcastle
Liverpool	LTP LCWIP 2019 Combined Authority Transport Plan (2019-2029) Liverpool City Region Combined Authority: A transport plan for Growth Cycling Strategy (2014-2026)	Air Quality Action Plan	Liverpool Active City Strategy (2014-21)
Manchester	LTP3 Transport Strategy 2040 Strategy for Cycling 2012/13	Zero-Carbon Manchester 2020 Air Quality Action Plan Green and Blue Infrastructure Strategy	Manchester Joint Health and Wellbeing Strategy 2016
Leeds	LTP3 LCWIP Leeds Transport Strategy 2016 Local sustainable transport fund	Air Quality Action Plan	Leeds Health and Wellbeing Strategy 2016-2021
York	LTP3 (2011-2031) Cycling City Strategy 2008	Air Quality Action Plan	
Chesterfield	Derbyshire LTP3 (2011-2026) Derbyshire Cycling Plan 2016-2030 Sustainable Modes of Travel Strategy 2019/20 Right of Way Improvement Plan for Derbyshire 2007	Derbyshire Carbon reduction Strategy 2011	Active Derbyshire
Derby	LTP3 (2011-2026) Local Sustainable Transport Funds 2015/16 Derbyshire Cycle Plan Future Mobility City Transforming Cities Fund Moving Derby Forwards Programme 2021	Derbyshire Carbon reduction Strategy 2011	Active Derbyshire

Birmingham	West Midland LTP (2011-2026) LCWIP 2020 Low Carbon Transport Strategy 2012 Birmingham Transport Plan 2031	Air Quality Action Plan Clear Air zone	Health and Wellbeing Strategy
Worcester	LTP4 (2017) Worcester Transport Strategy 2010	Worcester Climate Change Strategy 2012-2020 Net Zero Carbon Plan	Shaping Worcester Future 2017-2022
Southern-on-Sea	LTP3 (2011-2026) Local Sustainable Transport Fund 2016 Essex Cycling Strategy 2016	Air Quality Action Plan	Southend 2050 Low Carbon Energy &sustainability strategy 2015-2020
Cambridge	Cambridgeshire LTP3 (2014-2031) Transport Strategy for Cambridge and South Cambridgeshire (2014-2031) Bicycle Plan (2018-2020) Transport Investment Plan 2021	Air Quality Action Plan Climate Change Strategy (2016-2021)	
Woking	Surrey LTP3 LCWIP 2020 Cycle Woking 2008-2011 Woking sustainable Transport Project	Woking 2050	
Oxford	LTP4 (2015-2031) LCWIP 2020	Air Quality Action Plan Net Zero Oxford Action Plan 2021	
Plymouth	Join LTP City Centre Transport Strategy 2009 Plymouth Plan 2020	Air Quality Action Plan Climate Emergency Action Plan	
Bristol	JoinLTP4 LCWIP 2020 Bristol Transport Strategy 2019 Bristol Cycle Strategy 2015	Clear Air for Bristol	Bristol Active City

Most of the towns and cities present at least two transport related policies that focus on cycling, the most common one being the LTP, as mentioned earlier. Another main policy found in more the half of the city/town is the general Transport Plan of the local authorities. On these policies, the focus is the development of a transport strategy, and in all of them, there is a small section that is mostly dedicated to promoting more sustainable transport modes. The focus on cycle infrastructure and promotion will vary from place to place.

Most of the cities and towns have a balance between local and joint authorities or county transport strategies. In Manchester and York was only identified local strategies and in Sunderland and Chesterfield, all the strategies were or by combined authorities or by the county.

We notice that most of them have at least one of the main goals of the policies related to themes such as promotion of more sustainable transports and active travel, which directly involves more cycling. The only strategy notice there is a lack of strategies and goals for the promotion of cycling was in Worcester.

When analysing Worcestershire's LTP (2018-2020) it is clear that the main goals for the county are in three areas: Transport Technology, Travel Choice and Capacity Enhancement. The promotion of cycling is highlighted throughout the promotion of active travel as a transport mode. There is no clear and direct goal and strategy focusing on cycling, or the promotion of more sustainable transport modes. There is only a delimitation of a Strategic Active travel corridor scheme that connects the whole county. For strategies specificity for Worcester, the main strategies go around improving the infrastructure of corridors for all the transport modes and can include adding walking and cycling infrastructure.

When analysed the Derbyshire LTP for Chesterfield, the main strategies and the key transport investments sets are well maintained road and right of ways, efficient transport network management, improving local accessibility and achieving healthier travel habits, better safety and security and a considered approach to new infrastructure. On this plan, many strategies and schemes are focused on the promotion of cycling and indirect measures that can also increase cycling. There is the delimitation of many schemes and projects focusing on the Chesterfield area that aim to promote and increase cycling such as numbered individual sustainable transport projects focusing on reducing carbon emissions. This project varies from education and motivation programs and the improvements of the cycle network. Even there is a considerable number of strategies and programs that aim to increase cycling they are all for the county area, there is a lack of a local set of strategies where the focus is on determinate local targets and schemes.

Places such as Newcastle upon Tyne and Sunderland both have the same join LTP3. On this document there is a clear set of goals that are:

- To support the economic development, regeneration and competitiveness of Tyne and Wear, improving the efficiency, reliability and integration of transport networks across all modes
- To reduce carbon emissions produced by local transport movements, and to strengthen our networks against the effects of climate change and extreme weather events
- To contribute to healthier and safer communities in Tyne and Wear, with higher levels of physical activity and personal security
- To create a fairer Tyne and Wear, providing everyone with the opportunity to achieve their full potential and access a wide range of employment, training, facilities and services
- To protect, preserve and enhance our natural and built environments, improving quality of life and creating high quality public places

Even that these two places have joined LTP their cycling levels and cycling growth for the past decade are quite different. One of the motives is that Newcastle upon Tyne has a clear concert to increase cycling due to the development of local strategies focuses on cycling. On their local strategies, many schemes focus on increase the cycling levels, variating from improvements on the cycle network, integration with public transport and travel plans, training and encouragement. In Sunderland was not found and local transport strategy that focuses on cycling promotion.

For the more indirect cycling promotion, all the places have environmental strategies that highlight the importance of cycling. In most cities was possible to find on the websites environmental policies that indirectly promoted cycling, such as the Air Quality plan and Carbon-free Plans that aim to reduce the emission of air pollutant by promoting more sustainable transport option such as cycling. The promotion of cycling through health and wellbeing strategies is less popular, places such as York, Cambridge,

Oxford, Woking was not found any health and wellbeing strategy that can affect the cycle levels. The main way to promote cycling on these policies is by promoting active travel.

When we analyse the cities and towns chosen with the participation of national programs such as Cycling Demonstration Towns (CDT), Cycle Cities and Towns (CCTs) and Cycle City Ambitions (CCA), focus on promoting cycling we notice that almost all of them were included in at least one program. Sunderland, Liverpool, Chesterfield and Worcester are the town and cities that did not been beneficiated by and of these programs. Cambridge and Bristol were the only two cities in our selection that were included in two different programs at different time.

Table 8 – Towns and cities benefit from national programs.

Town and city	National programs		
	CDT (2005-2011)	CCTs (2008-2011)	CCA (2013-2017)
Sunderland	-	-	-
Newcastle upon Tyne	-	-	Yes
Liverpool	-	-	-
Manchester	-	-	Yes
Leeds	-	-	Yes
York	-	Yes	-
Chesterfield	-	-	-
Derby	Yes	-	-
Birmingham	-	-	Yes
Worcester	-	-	-
Southern-on-Sea	-	Yes	-
Cambridge	-	Yes	Yes
Woking	-	Yes	-
Oxford	-	-	Yes
Plymouth	-	-	-
Bristol	-	Yes	Yes

The main analysis from the policies and programs found to promote cycle found in the study case is that there is a local motivation to increase cycling, and the main reason is due to the positive impact that it can cause to the environment. Overall, we notice that the town/city with the high number of policies and strategies was Derby (8), Liverpool (7), Birmingham (7), Sunderland (7), Manchester (7) and Cambridge (6), and the ones with fewer policies and strategies found were Leeds (3). Most of the cities and towns present an average of five policies and strategies to increase cycling, which can go from transport planning to environmental and health.

All the cities have bikability and cycling training programs and are involved in national wide schemes such as cycle to work. The presence of schemes of bike hires and share is promoting only by Bristol (Yobike and Brompton), Plymouth (Donkey Republic), Oxford (Brompton) and Woking (Brompton).

It was identified that Cambridge and Derby are promoting E-bikes share schemes, however, the system in derby is temporarily suspended due to vandalism.

It is important to mention, there is a significant amount of these sustainable policies that were implemented last year until now, with a few motivated due to the impact of the COVID-19 outbreak and the impact of the pandemic on your cities.

5.3.4. BUILD INFRASTRUCTURE

As mentioned before, the presence of cycling infrastructure in the cities is a valuable tool to increase cycling levels. Cycle lanes and paths can guarantee more safety and security for cyclists and encourage more people to cycle. The analysis aim of this section is only to focus on highlighting the presence of basic bike infrastructure in each town and city. The identification of the infrastructure was through information gathered from the city council's Web site and plans and programs. At this point, we are not measuring the quality and the physical conditions of the infrastructure.

Throughout the visual analysis of maps, we note that all the cities and towns analysed in this work have a minimum cycle infrastructure. All cities and towns present cycle routes, most of which consist of sharing bike lanes on large streets in the city centre. The extensive network varieties from place to place, for example, the great Manchester region presented, in 2018, 633 km of cycling infrastructure, and city such as Woking has 39 km of cycling infrastructure in the city delimitation. Even there is a drastic difference in length it is important to remember that the area for the great Manchester is nearly twenty times bigger than the Woking area.

All the cities and towns present end-of-trip facilities, mostly by bike racks and parks located around the city centre. In places such as York, Woking and Cambridge, there are more than 1,000 bike racks spread around strategic locations of the city, such as train stations, bus stops, parks and the city centre. Besides that, it was found, in Bristol and Oxford, public bicycle pumps located around the city provide a tool for cyclists to maintain and promote safe biking.

5.3.5. TOPOGRAPHY

The topography is one of the main obstacles that cycling can face, as mentioned in chapter 3. The presence of steep terrain can propose challenges that, most of the time, scare the cyclist. To analyse the terrain of the English towns and cities selected for this work was use the maps provided from the website FloodMap that provide the elevation maps using data from NASA’s 90 m resolution SRTM data. Image 10 provide the maps for each city analyse.

Analysing the images collected we can notice that Cambridge, Oxford, Woking, York are the towns and cities with the most level terrain. Places such, Plymouth, Bristol, Leeds, Birmingham, New Castel upon Tyne and Sunderland present a terrain with greater elevations.

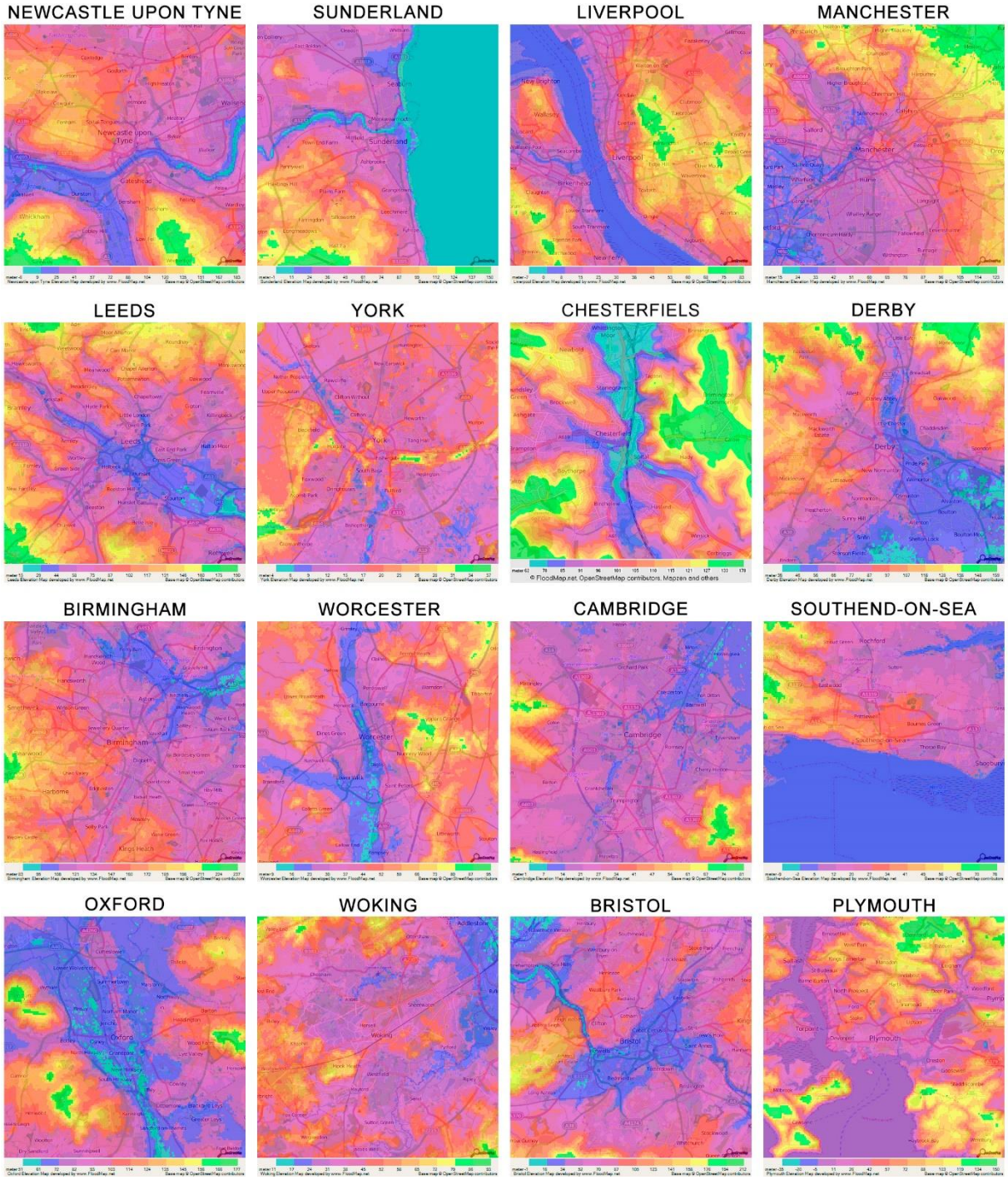

Figure 10 – Towns and cities topography map. Source FloodMap, 12/05/2021 (https://www.floodmap.net/Elevation/CountryElevationMap/?ct=GB)

Table 9 shows the main low and high levels of elevation within the city boundary shown in the maps selected. The primary goal is to discover the elevation variations existing within the city limits. This variation was established throughout a visual analysis from the maps obtained, was identify the predominant high and low elevations around the city and towns limits and the variation obtained by the differences of this values.

Higher variations of elevation mean the city tends to have steeper terrain, which can make cycling more challenging and flat areas can accept cycling more easily. Analysing the table below identifies that the flattest cities and towns are York, Cambridge, Woking, Southend-on-Sea, Derby, Worcester, Oxford and Liverpool. The hilliest ones are Plymouth, Bristol, Leeds, Birmingham and Sunderland.

Table 9 – Towns and cities elevation variations

Town and city	Main Low elevation (m)	Main High elevation (m)	Elevation Variation (m)
Sunderland	20	70	50
Newcastle upon Tyne	30	85	40
Liverpool	25	60	35
Manchester	40	80	40
Leeds	40	100	60
York	12	23	11
Chesterfield	80	120	40
Derby	50	80	30
Birmingham	130	185	55
Worcester	25	55	30
Southern-on-Sea	12	40	28
Cambridge	21	34	13
Woking	30	50	20
Oxford	65	100	35
Plymouth	11	80	69
Bristol	34	100	66

5.4. DISCUSSION

With all the data collected from the analysis, it is possible to compare the cycle levels, growth rates, existing policies, infrastructure and topography. Table 10 consists of all the main data obtained from the analysis showing a clear cross collection of data. The goal of this is to develop an understanding of how each factor affects the bike level in each town and town.

First, it is noticed that the cities and towns that obtained the highest levels of growth in the last decades, such as Woking, Cambridge, Oxford, Southend-on-Sea, Newcastle upon Tyne and Manchester, are the ones with the high cycle levels apart from Liverpool, that even with a 150% growth, the cycling levels is not one of the highest. York and Bristol have a considerable high cycle level for English standards, 7,4 and 5,7 respectively, but only the had a 68% and 63% of growth, respectively. The city with the highest growth was Woking and is not the one with the highest bike levels. The city with less growth was Worcester, with -40%, and it does present one of the lowest cycle levels. The same is valid for Chesterfield, which did not present any growth and is the one with the lowest cycling levels of the group.

The majority of cities and towns that exhibited significant levels of bicycle growth tend to show higher cycling levels. The same is valid for those with lower growth rates, who tend to have lower cycling

levels, such as Worcester, Chesterfield and Sunderland. The regions with the lowest and highest growth rate and the location of the cities and towns with the lowest and higher growth rate are the same. There is the compatibility of growth between the cities and regions.

Table 10 – Analysis of growth rates, cycling levels, terrains variation and presence of policies and program.

Town and City	Growth Rate	Cycle level 2019	Terrain Variation	National Cycling Program	Transport Policies	Env. Policies	Health Policies	Bike hire
Sunderland	33%	0,8	50	-	2	3	2	-
Newcastle upon Tyne	198%	3,2	55	Yes	3	1	1	-
Liverpool	150%	2	35	-	5	1	1	-
Manchester	156%	4,1	40	Yes	3	3	1	-
Leeds	63%	1,3	60	Yes	4	1	1	-
York	68%	7,4	11	Yes	2	1	-	-
Chesterfield	0%	0,5		-	4	1	1	-
Derby	35%	2,3	30	Yes	6	1	1	Yes
Birmingham	67%	1	55	Yes	4	2	1	-
Worcester	-40%	1,2	30	-	2	2	1	-
Southern-on-Sea	173%	3	28	Yes	3	1	1	-
Cambridge	108%	25	13	Yes	4	2	-	Yes
Woking	242%	4,1	20	Yes	4	1	-	Yes
Oxford	138%	16,4	35	Yes	2	3	-	Yes
Plymouth	75%	2,1	69	-	3	2	-	Yes
Bristol	63%	5,7	66	Yes	4	1	1	Yes

The existence of policies to promote cycling is fundamental to increasing and the popularization of this transportation mode. However, as we can see, in English towns and cities, the presence of many policies and programs does not necessarily mean high cycling levels. The place with more policy was Derby, and even that the city has cycling levels above the national average, still is lower when compared with the levels of the highest cycling level of England and was one of the cities with the lowest levels of growth rates since 2011, with only 35%. In places where cycling is more consolidated, such as Cambridge and Oxford, there are half of the amount of cycling promoting policies, in comparison to Derby, and present cycling levels ten times larger. With this, it is more important to develop policies with clear strategies, realistic goals and firmly implemented them can be more effective than the existence of a variety of policies but not well connected and coherent to the city.

It was identified two cities that only had local transport strategies (Manchester and York) and two with only join or county strategies (Sunderland and Chesterfield). Crossing the data with the cycling levels and growth, it is notable that those without local strategies present the lowest cycling levels of the select

group and lower growth rates. However, the cities with only local strategies both have good cycling rates, 4,1 and 7,4 respectively.

Cities with a balance of local and joint transport strategies have cycle levels above the national standard with positive cycling growth. However, Worcester is an exception, due to being the only city that decreased cycling levels. One reason for this decline may be the lack of clear and direct goals and strategies focusing on increasing cycling in their main transport plans. The same was identified in Chesterfield when analysing Derbyshire LTP, and as we know, the city has one of the lowest cycling levels and has not grown cycling over the past decade.

The presence of indirect policies that focus on sustainability, environmental and health and wellbeing can generate a good impact on the cycling levels, as mentioned in the previous chapter. However, it does not always happen, as can be seen in Worcester.

Due to the presence of bikeability and training programs in all the selected cities, is hard to determine the success of these programs on cycling at a local scale. However, on a national level, the main age group that cycle consisted of people from 16 to 24 years old, and the target of most of the bikeability programs is to training and encourage children to cycle to school, this embrace of the younger population may reflect these programs over the years.

Another main program identify is the presence of bike hire schemes and e-bike share schemes. All the cities that were identified in these schemes were Bristol, Plymouth, Oxford, Woking, Cambridge and Derby, which have cycle levels higher than the national levels and positive cycle growth.

Focus on national programs; all the cities and towns that participated in the National Schemes had a positive increase of the cycling levels with half obtain over 100% of growth in the last decade. All then participant cities and towns have high cycle levels excluding Leeds and Birmingham, that participated in the Cycle City Ambitions, and present cycling levels below the national average. Another exception is Liverpool, where they raised their cycling levels but did not take part in any of the cycling promotion programs. Implementation of national programs exclusively to promote and raise cycling levels has a positive outcome in all the analysed cities and towns. It helps shape the city's needs and generates a long positive impact, as we can see in the case of York and Woking. Both cities were in the Cycling City and Town (CCT), and even with the end of the program in 2011, they continue to present growth in their cycling, with Woking cycling levels growing 242% since the end of the program and having high cycling levels for the English parameters.

Even though it was identified cycle infrastructure in all the analyse cities there is a lack of efficiency that can help to promote and encourage more cycle. There is a large portion of the English population who still perceive cycling as dangerous and risky. This perception is generally encouraged by the lack of good bike infrastructure and efficient policies and programs. Cities such as Cambridge and Oxford have stabilised a good balance between promoting and investing in cycling that generates cycling levels as high as the Dutch, but in most cities around England, there is a considerable gap.

Cities and towns that presented a high number of end-of-trip facilities have the highest cycling levels in the country, such as York, Woking and Cambridge. In Oxford and Bristol, public bike pumps were also found, which contribute to more infrastructure and support for cyclists and can promote the high cycling levels existing in these places.

Analysing the topography, it delimited the cities with a more plane and hilly terrain. York, Cambridge, Working, Southend-on-Sea, derby, Worcester, Oxford and Liverpool as identify as the most plane cities. When we cross data with the cycling levels, it is noticeable that most of them present the highest cycling levels. Still, Worcester is the only one that still presents low levels of biking, even declining over the

years. The hilliest cities were Plymouth, Bristol, Leeds, Birmingham and Sunderland. With cross data analysis it is prominent that cities and towns with the most step terrain do not mean the lowest cycling levels. As we have Sunderland, Leeds and Birmingham with a considerable hilly city and with cycling levels lower than the national levels. However, the other two cities with steep terrain have cycling levels higher than the national average, particularly Bristol with a cycling average of 5,7. Also, all these cities showed a growth rate, not as high as those in plainer terrain, but this increase highlights that terrain can be an obstacle to cycling, but not prevent cities from having good cycling levels. It will depend on the policies and strategies that are being implemented and promote infrastructure and schemes, such as the use of e-bikes, according to the local needs.

6 CONCLUSION

As was highlighted by the literature, the English cycling levels are low, especially when compared to other countries from Europe. There had been an attempt to increase these levels by the development of policies and programs since 2000. However, most of these policies tend to set unrealistic targets and were not fully embraced by the government. Since 2011, a lot has changed in the English scenario. More policies were established, more infrastructure was built, and still, the English cycling levels remained low. Focusing on a national scale, it is easily noticed there are main obstacles and difficulties to embrace the utilitarian cycle.

For the past decades, the levels of cycling in the UK have been mostly stable, having a substation variation on the cycling level around different regions (Golbuff & Aldred, 2011). Most cities and towns are around the national average, and there are a few that cycling levels are higher, such as Cambridge and Oxford. Through the many local variations, it could be noticed that in some places the cycling culture has been in some extended normalised and the cycling levels rates are increasing significantly over the years (Aldred & Jungnickel, 2014).

There has been considerable growth from a local scale perspective. Places such as Newcastle upon Tyne, Manchester, Liverpool, York, Southend-on-Sea and Woking, that had considerable growth in the cycling levels since 2011, and even the cycling levels are still low compared to the Dutch levels, they are considered high to the English context. The policies makers and government need to look at all the policies that generate this growth to understand what policies and programs are being successful on a local scale to keep invest in these programs so these cities can keep growing and obtain cycle levels closer to Cambridge and Oxford.

There are major's disparities in the cycling levels on a regional and local scale. The best cycling levels of England are in the southern regions and the East of England, which are twice as high as the other regions. On a local scale, the biggest differences are evident, with Cambridge and Oxford presenting bike levels 13 and 8 times higher than the national average. As a result, these cities do not represent the reality of the English towns and cities; however, they show that it is possible to achieve, with the right policies and promotion, cycling levels similar to the Dutch.

In the other towns and cities with cycling levels higher than the national standard, their cycling levels are up to 5 times lower than those in Cambridge and Oxford. Places such as Woking, York, Bristol, Manchester, Liverpool, Newcastle upon Tyne and Southend-on-Sea presented the highest growth rate at cycling levels and had continually increased their cycling levels for the past ten years. Highlighting there has been policies and programs that have been successful and achieve better cycling levels and create other cities, outside the two main cities, that can have their own cycling culture.

Of course, this positive outcome is not reflected in all cities. Chesterfield did not increase their cycling levels over the past ten years, and Worcester, that has had a decrease in them. This shows there is a lack

of strong policies and there is resistance from some local councils and governments to adopt more effective measures that can increase cycling.

Overall, from the sixteen analyses city and town on this work, only two did not present any growth and better cycling levels. This shows us with stronger policies and motivation from the local and national government it is possible to increase the cycling levels from England. However, a more committed and cooperative approach is needed so that these levels can rise more effectively over the years and exceed the main barriers, such as the fear of cycling.

Policy makers need to develop measures to decrease differences between regions. This analysis made clear that the South and East regions have higher cycling levels and the North, Midlands and Yorkshire the lowest. However, individually, the towns and cities present a lot of potentials to increase and embrace cycling.

There is an increase of interventions such as the creation of more policies and programs during this period, such as the Local Transport Plans, Local Cycling and Walking Infrastructure Plan to assure the creation of strategies to increase cycling and the development of national schemes such as the Cycle City Ambition. All these new cycling promotion policies and the program had positive results, but they did not change the national levels on a grand scale. However, on a local and individual scale, this intervention's impact was more expressive.

The presence of the infrastructure is another key factor that can boost cycling. Even though all the study cities and towns were identified with cycling infrastructure, the policy makers must guarantee the development of a more connected network and ensure quality maintenance and safety of them. Also, is important that these infrastructures are spread around the town and not concentrated in specific areas, to avoid the segregation of the population that cycles.

Physical elements, such as terrain, are crucial to influencing cycling levels but are not the most determinant to ensure good cycle levels as we could see in this analysis. As mentioned in the literature, topography and weather can be an obstacle to embrace cycling, but not as much as is perceived by the non-cyclist. Cities like Bristol show that it is possible to embrace cycling even though the city presents hills and steep terrain. Of course, there is a physical restriction to areas that present slopes with over 8 per cent but using e-bikes and alternative routes can help overcome this barrier. Furthermore, most neighbourhood areas tend to exhibit fewer terrain variations, and as noted in the literature review, most of the utilitarian cyclists remain within the confines of their community.

Overall, this work concludes that the factors analyse, such as policies and programs, infrastructure and terrain variation, affect the cycling levels of the towns and cities. To a higher growth of the cycling levels, the cities and towns show that having a good balance between local and regional strategies is more efficient than a high number of policies. The presence of National Programs is an efficient measure to increase cycling levels and to help establish a cycling culture in towns and cities. It is important that these policies invest in improvements in cycle networks, to make them more connected, extensive and safer, create end-of-trip facilities and promote more integration of the cycle network with public transport. The topographic analysis shows that the presence of plain terrain can generate more cycling but does not exclude cities and towns with higher levels of terrain variations from being able to increase their cycling levels.

In the end, most cities and towns analysed show a positive change in cycling levels and are working to create more policies and programs focusing on increasing their levels, highlighting the potential of England to become a cycling nation.

In recent reports from the DfT, there was a considerable increase in the cycling levels over 2020, due to the COVID-19 pandemic. Motivated by this latest scenario most of the towns and cities and even the national government are establishing new policies and programs focus to maintain this increase led by the pandemic to consolidate the bicycle as the main transport mode in urban environments.

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