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<A Study on Young People's Behaviours and Determinants of Cycling in Post-Pandemic London>

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Being a dissertation submitted to the faculty of The Built Environment as part of the requirements for the award of ***<insert degree title here, e.g. MSc Spatial Planning>*** at University College London:

I declare that this dissertation is entirely my own work and that ideas, data, and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

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Abstract

Purpose

The purpose of this study is to explore the determinants of cycling among young people, and the impacts of the pandemic on the changes in their cycling behaviour and perceptions. Using a sample of university students in London, this study investigates which factors are more important to young people's cycling and the extent to which this epidemic influences their cycling behaviour and perceptions of the importance of cycling factors in the context of the new norms.

Results

The most important determinants of young people's cycling are weather, trip distance, season and climate, infrastructure, topography, and perceived safety. Comparing with the pre-pandemic period, Young people are using public transport less and cycling more. Although their average cycling frequency increases after the pandemic, most still never cycle due to the lack of safe cycle lanes and available bike-sharing facilities. Young people also cycle more for commuting and transport purposes and less for recreation and sports. By comparing the changes in their perceived importance of cycling factors, only cycling purpose, perceived benefits of cycling, perceived risks of virus infection and cycling behaviour of friends and family show a significant change. However their focus on virus protection diminishes as the pandemic becomes more normalised.

Conclusion

The pandemic is an opportunity for young people to cycle, and early actions need to be taken. The attention to weather, trip distance, season and climate, infrastructure, topography, and perceived safety should be strengthened in future research and transport planning. To build safe, traffic-separated, school-linked cycling paths and bike-sharing facilities in London is crucial to promote cycling among young people. The results of this study may have implications for cycling planning in the post-epidemic era or the new normal.

CHAPTER 1: Introduction

With the ratification of the Paris Agreement, most countries in the world have recognised the need to work together to tackle climate change and develop a climate agreement (Deng, Wang & Yousefpour, 2017). The academic field, governments, social media, and the general public also have recognised and accepted the urgency and need of global action to address climate change (Huq & Toulmin, 2006). In this context, a low-carbon transition in transport is critical to the global response to climate change and to achieving sustainable development. Cycling, which has been proven to have many environmental and health benefits as a sustainable transport alternative to private car, is one of the key measures for a low-carbon transport transition (Pucher & Buehler, 2012).

The younger generation is an important part of the population and the mainstay of future travel, and they are generally perceived to be more concerned about climate change (Corner et al., 2015). Young people's travel behaviour is also shifting towards a greater willingness to active transport, particularly for those aged 20 to 40 (Etminani-Ghasrodashti, Paydar & Hamidi, 2018). Thus research into their travel behaviour is vital to promoting cycling. Some studies of young people travelling focus on groups born in the 1980s and 1990s, also known as millennials or Generation Y (Etminani-Ghasrodashti, Paydar & Hamidi, 2018), who are less likely to drive, own a car, or rely on driving in the same way as previous generations in countries such as the US, UK, Canada and Australia (Hopkins & Stephenson, 2014). Some studies on young people's travel patterns have used university students as research subjects (Mitra & Nash, 2019; Swiers, Pritchard & Gee, 2017), but the sample of unviersity students in some studies was small, less diverse, and focused on the school-related travel such as Akar, Fischer & Namgung (2013).

As a metropolitan city, London attracts students from all over the world with different backgrounds. According to the London Higher Factsheet 2019, there were nearly 38,200 students studying at 40 higher education institutions in London in 2018, accounting for 16% of the UK total. 30% of these were foreign students, including 32% EU countries' students and 68% non-EU students. As a result, university students in London are a highly mobile, international, diverse and large group whose views are not well known in research on cycling. Thus this dissertation will target university students in London to study the cycling behaviours and perceptions of the highly educated young people aged 18-30 years old.

Furthermore, the COVID-19 pandemic has had a significant impact on people's mobility (Zafri et al., 2021). The impact of the pandemic on travel demand has been studied by Bucsky (2020), and changes in transport mode choice behaviour have been examined (Abdullah et al., 2020). However, there is a research gap regarding the impact of the pandemic on perceptions and behaviour towards cycling with a focus on young people, particularly those with international backgrounds and temporarily living in cities where they are studying. This study will therefore explore the targets that need special attention in promoting cycling among young people in an epidemiological context, and the findings will contribute to the long-term sustainable planning recommendations for post-pandemic cities, and here post-pandemic London.

In previous research, socio-ecological models and the theory of planned behaviour (TPB) have often been used as the theoretical basis for exploring travel behaviour. The socio-ecological model suggests that behaviour is influenced by the individual, the physical environment and the social context (Sallis, Owen & Fisher, 2015), whereas TPB suggests that behaviour is driven by intentions, which are determined by attitudes, perceived behavioural control and subjective norms (Ajzen, 1991). This study will also use these two behavioural theories as a theoretical framework to investigate young people's cycling behaviour.

Aim and Key questions

The aim of this dissertation is therefore to examine the determinants of cycling among highly educated young people in London, and the impacts of the pandemic on the changes of their behaviour and perceptions.

Under the research context, this dissertation will examine the following two research questions:

1. What are the perceived determinants for a shift to low-carbon transport modes that encourage cycling, with the focus on young people?
2. To what extent has the pandemic influenced the behaviour and perceived determinants of cycling, here university students?

Firstly, this dissertation will use behavioural theories as a theoretical foundation, review the existing literature about the traditional determinants of cycling, young people' s cycling behaviours, and pandemic impacts on cycling behaviour (Chapter 2). Then, the research methodology will be explained in Chapter 3, including research design, data collection methods, data analysis methods, limitations and difficulties. Next, Chapter 4 will analyze and discuss the collected data results. Finally, Chapter 5 will draw conclusions and give recommendations in the future planning field.

CHAPTER 2: Literature Review

2.1 Introduction

This chapter will first introduce the application of behavioural theories to the field of transport and cycling, next review the existing literature examining cycling-related factors, also with some focus on specific groups of young people, and finally explore the pandemic impacts on people' s cycling behaviour in current research.

2.2 Behavioural theories

"Behaviour" is defined as a process in which a person is subjected to a stimulus or event that leads to an intention or motive, and a theory that describes any part of this reaction or decision-making process is referred to as a "behavioural theory" (Kwon & Silva, 2020). There has been a significant increase in research interest in behavioural theories across all disciplinary areas, and many behavioural theories used in other disciplines have potential to be adopted into planning (Kwon & Silva, 2020). In previous transport studies of travel behaviour, socio-ecological models and the theory of planned behaviour (TPB) are commonly used as the conceptual framework (Acheampong, 2017).

Socio-ecological models are commonly used in the field of public health and argue that behaviour is influenced by multiple factors, including individual factor as well as social and physical environment (Sallis, Owen & Fisher, 2015). Individual factors include attitudes, preferences, confidence in one's ability to engage in behaviour, the physical environment includes the natural and built environment, and the social environment includes the social norms of the community (Handy & Xing, 2011). This model is often used in cycling research to explore the relationship between cycling

behaviour and these factors. For example, the study of Robertson-Wilson, Leatherdale & Wong (2008) examines the relationship between demographic, behavioural, social/psychological and environmental correlates of active school commuting among high school students in Ontario, Canada, resulting that active commuting to school are influenced by a variety of factors. Handy & Xing (2011) focus on the relationship between bicycle commuting and socio-demographic characteristics, personal attitudes, and the physical and social environment of the workplace in six small cities in the US, finding the impact of good cycling environment on cycling commuting.

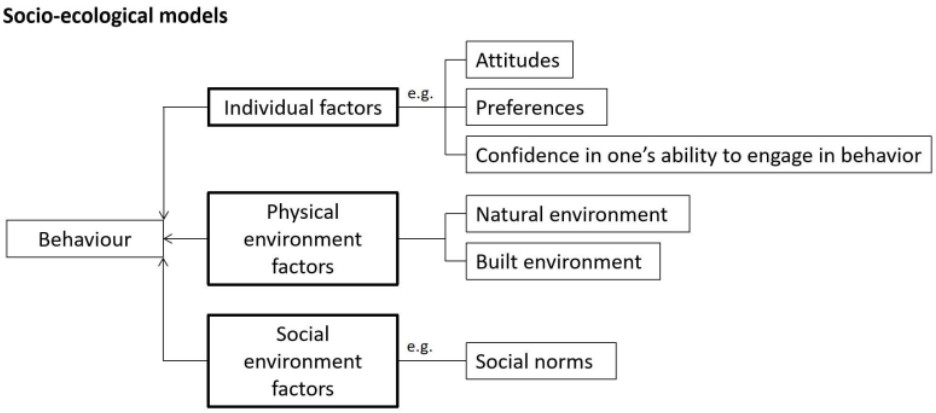

Figure 1: the socio-ecological models (made by the author)

TPB is a social cognitive framework from psychology which states that behaviours can be predicted by executing their intentions, which in turn are influenced by attitudes, perceived behaviour control (the control that people perceive they have over their own behaviour) and subjective norms (the social norms that people perceive as dominant around them) (Ajzen, 1991). In planning and design, TPB could be adopted to explain and predict possible behaviours, and is more effective to identify targets for changing cognition than to develop interventions that lead to behaviour change (Morris et al., 2012). In transport and mobility studies, TPB is mainly used to predict intentions for car transport reduction and sustainable transport behaviour, in

addition to this other explanatory intentions or behavioural factors are also explored in some studies (Liu et al., 2017). For instance, de Bruijn et al. (2009) explore the habitual intensity of cycling as a means of transport in Amsterdam in the context of TPB and show that the intention correlation decreases when cycling increases habitual intensity. A TPB-based study on college students' bus use by Bamberg, Ajzen & Schmidt (2003) finds that the intervention could affect attitudes, subjective norms and perceived behavioural control over transit use, as well as intended intentions and behaviours, and the TPB accurately predicts intentions and behaviours before and after the intervention.

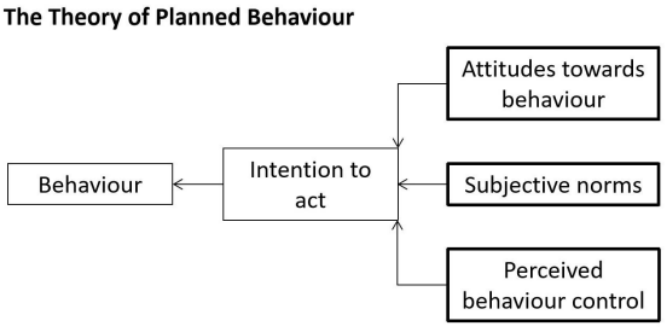

Figure 2: the Theory of Planned Behaviour (made by the author)

This study will therefore use both socio-ecological models and TPB as a theoretical framework to examine the factors that influence the cycling behaviour of young people in London.

2.3 Traditional determinants of cycling behavior

The influence factors of cycling can be categorized into built environment factors, natural environment factors, trip factors, and psychological and social factors.

Built environment factors

Build environment factors, including urban form, urban greenery and infrastructure are confirmed as significant factors of cycling in a number of research. Firstly, urban form factors such as a denser network layout, higher address density and mixed functions could positively influence cycling due to its effect on trip distance (Heinen, Van Wee & Maat, 2010). The impacts of population and address density, land-use concepts, building diversity and urban design are proved by several empirical studies (Ewing & Cervero, 2010; Zahabi et al., 2016; Gao et al., 2018). According to Heesch, Giles-Corti & Turrell (2015), urban greenery such as number of green spaces, exist of street trees and objective neighborhood environment are also significant factors of cycling. Furthermore, infrastructure is studied in relation to bicycle use, such as cycling paths, lanes, streets, parking facilities and signs, and traffic lights (Heinen, Van Wee & Maat, 2010), as well as the short distances of bike lanes and the separation of bike lanes from traffic are also studied (Heesch, Giles-Corti & Turrell, 2015),. However, some studies do not clearly distinguish between the objective and perceived environments such as Panter & Jones (2010). It is important to note that the results of objective and perceptual measures of the built environment are different, and objective measurements are more reliable than perceptual measurements, while perceptual measurement can be used as a complement to objective measurement studies (Yang et al., 2019). Additionally, few studies focus on the extent to which the built environment affects cycling decisions, and even fewer focus on cycling frequency (Heinen, Van Wee & Maat, 2010).

Natural environment factors

Natural environment including weather, topography, season and climate, and daylight hours is also a significant factor of cycling in some studies (Heesch, Giles-Corti & Turrell, 2014; Gao et al., 2018; Wong, Faulkner, & Buliung, 2011). Firstly, rain is often considered as the most negative weather factor (Brandenburg, Matzarakis & Arnberger, 2004), in addition to low temperatures which could also reduce cycling (Heinen, Van Wee & Maat, 2010). Unusual weather conditions can

reduce the use of bicycles by as much as 30% (Fernández-Heredia, Monzón & Jara-Díaz, 2014). Sunshine and warm weather are positively associated with cycling, while cold and windy are opposite (Gao et al., 2018). With regards to topography, hilliness often has negative effects on cycling (Heinen, Van Wee & Maat, 2010), but some towns with unfavourable topography have a high proportion of cycling patterns (Fernández-Heredia, Monzón & Jara-Díaz, 2014), and experienced cyclists also prefer hilly environment (Heinen, Van Wee & Maat, 2010). As for seasons and climate, cycling rate increases in summer and decreases sharply in winter (Heinen, Van Wee & Maat, 2010), and the mode share of cycling decreases more in areas with colder climates in winter (Stinson & Bhat, 2004). Additionally, daylight hours could also affect cycling due to the negative effect of darkness (Gatersleben & Appleton, 2007).

Trip factors

Trip factors including trip distance, costs, travel purpose and traffic congestion are identified as an important factor of cycling. Base on Heinen, Van Wee & Maat (2010), as trip distances increase, cycling becomes generally a much smaller proportion of mode choice and commuting and less convenient, requiring more travel time and effort, and cycling trip times even are seen as three times longer than other modes, leading to the negative cycling attitudes. Usually shorter trips are preferred by experienced cyclists, but those who cycle for the effort (such as those who like to exercise or keep fit) may even prefer longer commuting distances (Heinen, Van Wee & Maat, 2010). As for influence of costs, when other transport is more expensive, the share of cycling increases (Heinen, Van Wee & Maat, 2010) due to the relatively lower price of cycling, which is also one of the reasons why commuters choose cycling (Bergström & Magnussen, 2003). Different purpose could also cause different preference of cyclists (Nkurunziza, Van Maarseveen & Zuidgeest, 2010). It is necessary to distinguish cycling purpose as separate studies of cycling behaviour for the purposes of transport, commuting, recreation and general present different results (Mohammed, Ukai & Hall, 2022). Additionally, traffic congestion could affect cycling, as increased travel time and energy could lead to fewer people choosing to

cycling (Gatersleben & Uzzell, 2007), with the exception of some cyclists who ride for the purpose of sports and health (Heinen, Van Wee & Maat, 2010). Considering of the time costs of public transport and parking costs of driving, flexibility is also one reason of cycling choice (Akar & Clifton, 2009).

Psychological and social factors

A number of studies have addressed the impact of psychological and social factors on cycling, which include attitudes, habits, perceptions, and social environment. Positive attitudes towards cycling could increase cycling possibility (Heinen, Van Wee & Maat, 2010; Dill & Voros, 2007; Willis, Manaugh & El-Geneidy, 2015). Pro-environmental attitudes and attitudes that see cycling as exercise are also attitudinal factors which positively affect cycling (Damant-Sirois & El-Geneidy, 2015), as well as negative attitudes towards other transport mode and preference for active travel (Willis, Manaugh & El-Geneidy, 2015). Furthermore, habits also could affect cycling choice and frequency. People accustomed to a certain mode of transport are less likely to look for new options (Heinen, Van Wee & Maat, 2010). Those with cycling habits are more likely to choose cycling in the future (Willis, Manaugh & El-Geneidy, 2015). As for perceptions, perceptions of benefits and barriers, perceived safety, knowledge and perception of cycling routes, cyclists and parents, and perceived behavioural control are studied as significant factors of cycling according to Willis, Manaugh & El-Geneidy (2015). Among them, safety is studied as a common reason of not choosing cycling, including not only objective safety but also subjective perceptions (Heinen, Van Wee & Maat, 2010). Making people feel safe anywhere in the city is more important than infrastructure for increasing cycling (Damant-Sirois & El-Geneidy, 2015). Cycling is generally less safe than other transport mode including walking, driving and public transport in people's mind, but cyclists have relatively higher safety perception (Heinen, Van Wee & Maat, 2010). Additionally, social environmental factors are significantly associated with cycling frequency, such as subjective and descriptive norm, influence of parental behaviour on children, social acceptance of cycling, and work environment (Willis, Manaugh & El-Geneidy, 2015).

The social and peer support are also found to have positive impacts on cycling (Damant-Sirois & El-Geneidy, 2015). It must be noted that, attitudes, perceived behaviour control (perceived ability to cycle), and subjective norms (social support) are also factors in TPB.

2.4 Young people's cycling behaviour

The research on young people's travel behaviour has been focused on the 'Millennials' born between 1980 and 2000 in many studies (Etminani-Ghasrodashti, Paydar & Hamidi, 2018). According to Polzin, Chu & Godfrey (2014), Millennials' travel behavior trends differ from previous generations, as evidenced by living with parents longer, obtaining driving licence at an older age, delaying marriage and childbearing, and working and socializing through telecommuting and social media instead of traveling, due to factors including place of residence, race/ethnicity, labor force participation, education level, income, living arrangements, life-cycle status, license status, vehicle ownership/availability, values, and propensity for technology to replace travel. Blumenberg et al. (2012) also explain that reasons for differences in young people's travel behaviour compared to adults include their early and frequent adoption of new communication technologies, the uniform adoption of driver's licence for graduation increasing its difficulty, and the impacts of prolonged economic decline. In addition, millennials prefer active transportation rather than car-oriented travel in some developed countries including the UK (Etminani-Ghasrodashti, Paydar & Hamidi, 2018). Yet while millennials are willingly more likely to use public and active transport, they may share the same car travel characteristics as older generations (Newbold & Scott, 2017).

Furthermore, the travel behaviour and perceptions of university students, an important group of young people, are of high value for research. Much of the current research on young people's travel focuses on a non-random sample of students as a

target group (Etminani-Ghasrodashti, Paydar & Hamidi, 2018). Whalen, Páez & Carrasco (2013) show that students and university staff are more likely to use more active and healthy modes of transport, such as walking or cycling, than other groups. Travel patterns and the potential for cycling and walking in the university context have also been extensively researched (Hidalgo-González, Rodríguez-Fernández & Pérez-Neira, 2022).

Some studies have explored the factors related to young people's travel patterns. Firstly, economic factors (e.g. income levels) and attitudinal preferences and lifestyles (e.g. lifestyle shift towards adoption of communication technologies, and preference for active travel) are stated as main factors of school-related travel in some studies (Etminani-Ghasrodashti, Paydar & Hamidi, 2018). Besides, the environmental, personal and social factors are also important factors base on the studies of children and adolescents by Sirard & Slater (2008) and Brunton et al. (2006) and the study of university students by Titze et al. (2007). Garrison (2015) also confirms the influence of livable neighborhoods factors (i.e. road attributes, cycling, pedestrian and transport facilities, land use, reasons for access of campus neighbourhood, location of the neighbourhood and distance from the campus), social demographic factors (e.g. age, income, gender) and preference factors (e.g. enjoyment of travel, life responsibilities, environment, traffic congestion, and travel cost) on students' travel. Moreover, weather-related factors, land use and the built environment have been shown to influence bike-sharing use (Wang, Akar & Chen, 2018), but they do not represent an impact on all cycling use. However, some studies of students' travel behaviour often focus on their travel behavior in commuting to school and ignore non-commuting trips, even though they are both critical to the development of effective transport measures and urban community planning (Sottile et al., 2022). In addition, a study of young people from different nationalities with higher education (Basaran, Kristoffersen & Haustein, 2021) shows a significant increase in the perception of safety and cycling frequency among young people who moved to Denmark compared to their original nationality, with the factors influencing the

perception of safety including the age of learning cycling, anger from car drivers, and unfamiliarity of cycling rules, and the factors influencing cycling frequency including attitudes towards cycling and regulation in their origin country. This means that different nationalities and cultural backgrounds can also influence travel behaviour.

2.5 Pandemic impacts on cycling behaviour

Pandemic impacts on travel behaviour

People's travel behaviour has changed in response to the fear of the disease spreading and the corresponding active rules and restrictions (Shakibaei et al., 2021; Beck & Hensher, 2020). According to Shakibaei et al. (2021), past studies of viral epidemics such as SARS and H1N1 have shown that mobility declines significantly, but not for long, with disruptive effects on travel behaviour only occurring during pandemics. As for the impact of COVID-19 pandemic on travel behaviour, there have been a number of empirical studies, however they only indicate short-term changes which cannot represent the long-term effects in post-pandemic environment.

Firstly, a common finding in these empirical studies is the reduction in the use of public transport following the pandemic. Because public transport is seen as a vector for spreading the virus, people prefer to use other modes such as walking, cycling or private modes rather than public transport (Nikitas et al., 2021). For instances, in Bucsky' s study (2020) of Budapest, Hungary, mobility is halved due to epidemiological measures, with the greatest reduction in demand for public transport (up to 80%) and the smallest reduction in cycling and bike-sharing, while at the same time the cycling share doubles from 2% to 4%, the car share increases from 43% to 65%, and the public transport declines from 43% to 18%. Besides, Conrow, Campbell & Kingham (2021) demonstrate that the travel behaviour before and after the pandemic remains unchanged in the perception of most New Zealanders, and only the public transport modes are reduced in the long term, while active travels

just increase temporarily during the lockdown.

Furthermore, these impacts of the COVID-19 pandemic on transport patterns can be both a threat and an opportunity (Laverty et al., 2020). Firstly, a proportion of public transport users are switching to private modes such as vehicles and motorbikes, which could be one setback to achieving sustainable transport outcomes (Bucsky, 2020). This might cause health problems in terms of reduced physical activities and environmental problems in terms of increased carbon emissions, thus measures are needed to encourage a shift from private travel to active alternatives (Zafri et al., 2021). Moreover, even if people tend to use safer transport modes after the epidemic, the shift from private cars to non-motorised modes is not evident in current studies, due to the lack of pedestrian and cycling infrastructure (Abdullah et al., 2020). On the other hand, the pandemic could also provide an opportunity for individuals and governments to shift to active travel modes, due to chronic limitations in public transport capacity (Laverty et al., 2020) and the increased awareness of the importance of active travel (De Vos, 2020; Hadjidemetriou et al., 2020). In response to the pandemic impact, some local authorities have made efforts to promote active transport and promoted walking and cycling as a safe way to travel during the pandemic (Conrow, Campbell & Kingham, 2021). Take London as an example, Transport for London (TfL) has built segregated cycling infrastructure that doubles in number, created new cycle lanes in the capital centre, provided cycling space from car streets, connected fully segregated cycle lanes to major destinations, and created dozens of ‘low volume’ communities (O'Malley, 2021). In addition, bike-sharing trips increased in London during the lockdown due to restrictions on other public transport systems (Li et al., 2021), and TfL has expanded the plan of shared bicycle to meet the increased demand (Intelligent Transport, 2020).

Factors of cycling behaviour in the post-pandemic era

There have been many studies on the factors influencing travel behaviour after the pandemic. Firstly, as for the factors of mode choice, people placed greater importance on factors they perceived to be associated with the risk of infection (such as safety, social distance and wearing a mask), and less on comfort, cost and travel time savings, while the importance of gender, car ownership, employment status, travel distance and purpose remained (Abdullah et al., 2020). Older people, non-white populations, low-income groups, and people with poor health or anxiety were less willing or less likely to use public transport than before the epidemic (Jiao & Azimian, 2021). Secondly, with a regard to factors that led to changes of active transport, people's income, regular travel mode and frequency of travel by active transport before the pandemic, expected changes in travel frequency under the new norm, perceptions of risk, bicycle ownership, availability of supportive infrastructure in the community, concerns about the economic impact of the epidemic, perceptions of own immune system, and willingness to go out were confirmed base on Zafri et al. (2021). To stay healthy, active and to rest from family activities were proved as the main drivers of active travel during the lockdown, and the reduction in traffic and quieter and safer streets were also facilitators (Conrow, Campbell & Kingham, 2021).

However, although the current studies have researched on trends, changes and responses to post-epidemic travel behaviour, impacts of pandemic on factors of mode choice and active transport, there is still a research gap regarding the determinants of cycling promotion in the new post-pandemic norm and the impact of the pandemic on them. Budi et al. (2021) demonstrated that the main factors of increased cycling trends during the pandemic include health, environmental protection, media influence and lifestyle factors, with lifestyle being the determinant. Cycling is likely to continue to increase in the coming years due to the expansions and improvements of cycling infrastructures, increased bicycle sales, new travel habits and familiarity with cycling among new and more frequent cyclists, recovery of

cycling trips after the new normal, and an increase in users switching from public transport to cycling (Buehler & Pucher, 2021). However, these studies only focus on the factors that contribute to the trend of increased cycling and does not address the factors that contribute to people's subjective choices and preferences for cycling. Besides, by using TPB and Technology acceptance model, the impacts of pandemic on cycling willingness are studied, showing that the awareness of environment and climate change issues and disadvantages of vehicles are improved after the pandemic and that subjective norms, perceived behavioural control, changes in consciousness, plans and activities about cycling and separated cycling lanes could influence cycling intents, while the impact of attitudes and perceptions was not significant (Irawan, Bastarianto & Priyanto, 2022). It investigates the impact of pandemic on the factors and facilitators of cycling intentions but is not comprehensive in terms of the variables involved and does not address the determinants and barriers of cycling behaviour.

2.6 Summary

To sum up, this chapter begins by exploring socio-ecological models and TPB, which are commonly used as behavioural theories for the studies of transport. This is followed by a summary of the traditional determinants of cycling behaviour including built environment, natural environment, trip factors, socio-economic factors, and psychological and social factors, where these factors are consistent with socio-ecological models, and the traditional psychological and social factors are echoed in the TPB of attitudes, perceived behaviour control and subjective norms. The chapter then reviews the characteristics and determinants of cycling for this particular group of young people and presents a number of studies of young people that have focused on university students. The impact of the pandemic on cycling behaviour and its determinants is also discussed. The post-epidemic trend is towards less use of public transport, and it is both a risk and an opportunity to promote

cycling. The added determinants of travel after the epidemic include factors related to the risk of infection and the desire to get out of the house.

In doing so, this dissertation attempts to fill in some of the gaps in the literature. This includes:

1. Focusing on the determinants of cycling in terms of young people's perceptions, examine how young people's behaviors and perceptions have changed since the new normalization of the pandemic compared to before the pandemic. To date, there is still limited knowledge on the latest.
2. Using London as a case study, zoom on a specific category of young people, those who are highly educated, highly mobile and culturally diverse. To date not many transport studies have been examining their perceptions and behaviors and here London's unique international economic and cultural background provides a relevant place to do so.

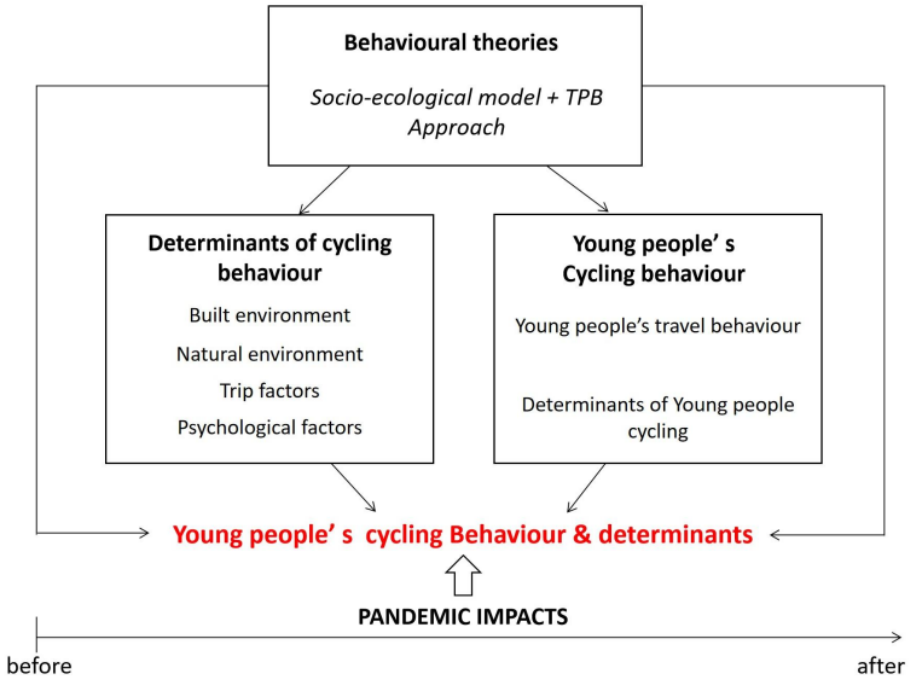

Figure 3: the theoretical framework of this study (made by the author)

CHAPTER 3: Methodology

3.1 Introduction

This chapter will first introduce the research design methods including qualitative and quantitative research, as well as a case study. Then the methods to collect data including secondary primary data will be demonstrated in detail. This is followed by the data analysis methods, and the limitations in this research. The final part will present the research ethics.

3.2 Research design

The quantitative and qualitative research methods and a case study were used in this thesis. Quantitative method usually refers to the use of scientific methods for data analysis, such as experimental control and manipulation of variables, collection of empirical data, data modelling and analysis (Gray et al., 2007). In this study, the quantitative research was conducted by administering a questionnaire which consisted of both closed and open-ended questions. It allows a large number of targets to be tested in less time and with larger data, and the results are relatively reliable and objective (Steckler et al., 1992).

Qualitative research refers to a range of data collection and analysis techniques used to explore people's behaviour, emotions, attitudes, and experiences, based on methods of interpreting social reality and descriptions of human life experiences including interviews (Mohajan, 2018). In this study, short follow up semi-structured interviews were conducted after the questionnaire survey to understand the views of participants. This allows for the study of the meaning beyond the data representation of quantitative research (Lune & Berg, 2017).

A case study refers to an in-depth investigation of a specific case, possibly for a location, individual or policy (Green & Thorogood, 2018). It is a type of empirical research in which the goal is to develop theories about the causes of similarities or differences between examples (George & Bennett, 2005). This thesis used the city of London, UK, which is the capital of the UK and a cosmopolitan city, as a case study.

3.3 Data collection

This dissertation collected both secondary and primary data. Firstly, the review of existing literature using the secondary sources formed the basis of key knowledge and subsequent primary research in this subject area, in order to understand young people's cycling behaviour, and to understand the possible impact of the pandemic on them.

As for the collection of primary data, an online questionnaire survey based on the literature review was conducted to empirically validate these findings. The survey participants were young Londoners, with a predominantly international university student population, because university students are often the subject of studies on young people's mobility, and they are likely to have learned climate change. The international university students in London are even a special, cosmopolitan and highly mobile group who live in London only temporarily, but in large numbers.
Due to the impact of the COVID-19 pandemic, questionnaires were distributed online to my friends in London in August 2022. A total of 78 valid answers were collected, of which 34.62% were male, 65.38% were female, and the age range was 18 to 30. Their education level was 9% Bachelor, 83.33% Master, and 7.69% PhD. 75.64% of them did not have a car or bicycle, 17.95% had a bicycle, and 6.41% had a car.

To assess their travel behaviour, the first part of questionnaire collected their basic socio-demographic data and relevant travel behaviours including usual transport

mode, cycling frequency and cycling purpose. To examine their perceived determinants of cycling and changes before and after the epidemic, part two used 5-Likert scale questions and open boxes to evaluate the importance of respondents' perceived cycling factors and to differentiate between current and pre-epidemic periods.

After collecting the questionnaires data, online interviews were conducted with 6 respondents who had volunteered to be interviewed, in the form of the online voice call. The semi-structured interview questions were based on their answers in the questionnaire. This was also the collection of primary data.

3.4 Data analysis

For the results of the questionnaire survey, statistical analysis was first used. For the first part of the questionnaire, statistic analysis were carried out on their travel behaviours including usual transport mode, cycling frequency, and cycling purpose. To analyse the second part of the questionnaire, the mean values of the perceived importance of the factors of cycling, both currently and before the pandemic, were counted separately and these factors were ranked in descending order of importance in order to explore the determinants of young people's perceptions of cycling.

In order to accurately explore changes in the perceived determinants of cycling between the present and pre-epidemic period, three tests including Kolmogorov-Smirnov (KS) test and Wilcoxon signed-rank (WS) test were conducted using SPSS. KS test is a non-parametric test which compares data to a known hypothetical probability distribution and is often used as a normality test to see if the data is normally distributed (Drezner & Turel, 2011). WS test is also a non-parametric test for comparison between two correlated samples, matched samples or repeated measures of a single sample to test whether their population mean rank is different

(Xia, 2020). When comparing the results of two related pairs of data, the Paired t test is frequently used, which is a parametric test to examine if there is statistical evidence that the mean difference between paired observations is significantly different from zero, However, it cannot be used for data that is not normally distributed (Hoffman, 2015). According to the results of the KS test in this study (see appendix), the importance of the cycling factor before and after the epidemic did not conform to a normal distribution, so the Paired t test could not be used and the WS test was finally chosen instead. This method allows for more reliable and valid evidence of the impact of the pandemic on perceived importance of cycling factors for young people.

For the interviews, a manual coding method was used in a descriptive way, which aimed to explain the changes in people's travel behaviour before and after the epidemic and the importance of people's perceived cycling factors. This also explains and complements the results of the questionnaire data.

3.5 Limitations

The sample size collected for this study was too small and unevenly split between males and females due to the limited study time and survey scope. Respondents were all international students, which may make this sample unrepresentative of all groups in London. The questionnaire was set up with too many questions, which may cause respondents become tired in answering the questions and not takes them seriously. There was also a risk that the questions in the questionnaire were not accurately understood by the respondents, leading them to answer incorrectly.

3.6 Ethics

Participants faced a low ethical risk as a result of this dissertation. Questionnaires and interviews were conducted anonymously and were allowed to be primarily online. All of the questionnaire survey and interviews ensured that participants were voluntary. In accordance with University College London's data protection principles and the Research Ethics Committee, no identifying data will be used other than a brief description of the participant's age, educational background, and car ownership (unless explicit permission is obtained). Respondents also have the right to refuse to answer any questions they do not wish to answer.

CHAPTER 4: Data Analysis

4.1 How young people's cycling behaviours have changed after the pandemic?

From the results of usual travel mode, it is clear that whether before or after the epidemic, most respondents usually use the metro and walking, all accounting for above 78%. Another popular way to travel before and after the pandemic is taxis/Uber, with more than half of its users. Other common modes of travel that are not differ before and after the pandemic include private cars and e-bikes/motorcycles, which are chosen by less than 5% of respondents, indicating that they are not the preferred transport mode for young people. Cycling is also not a popular way, with less than one fifth usually cycling both before and after the pandemic. Furthermore, figure 4 shows the biggest change in young people's usual transport mode after the pandemic is their use of bus (from 60% to 46%), followed by the use of metro (from 85% to 79%), and this is an important finding in the understanding of the impacts of pandemic on transport choice. This reduced use of public transport after the pandemic are consistent with the common results in other empirical studies. Another promising finding is that the use of cycling, taxi/Uber, and walking all increase slightly after the pandemic. These findings confirms the statement that people are more likely to use other travel modes after the pandemic as public transport has been seen as a vector for spreading the virus (Nikitas et al., 2021). As reviewed in the literature, the impact of the pandemic on active travel including cycling and walking could be both negative and positive (Laverty et al., 2020), as identical to Bucsky's findings that a proportion of public transport users switches to private modes (taxis/Uber in this study), and in common with Laverty et al. (2020) and Buehler & Pucher (2021), some shifts to active modes including cycling and walking. The interview data also confirms this statement to some extent, but

with a different perspective. Most interviewees state that they are willing to take the metro and buss less often after the pandemic considering the unsafety and risks of infection, but those who are used to commute by public transport could not change their usual travel mode easily, and would just wear a mask for protection.

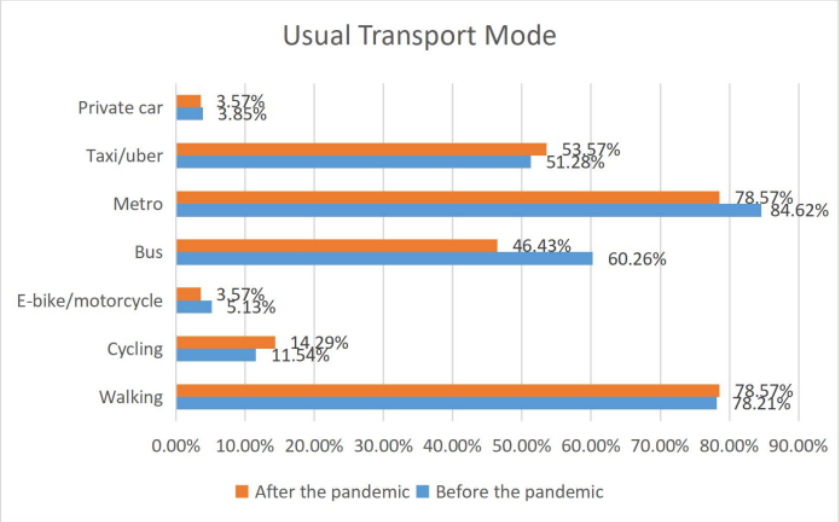

Figure 4: the usual transport mode before and after the pandemic (made by the author)

If cycling frequency is graded from low to high (never, less than once a month, once a month, a few times a month, once a week, a few times a week, everyday) on a scale of 1-7 and multiplied by the percentage of respondents at each level to obtain the average frequency, the average frequency before and after the pandemic would be 1.7141 and 1.9223 respectively, indicating an increase after the pandemic. This is consistent with the small increase in respondents choosing cycling as their usual travel mode after the epidemic shown in figure 4. This result is similar to Nikitas et al. (2021) showing that people are more likely to cycle after the epidemic, however this is not common to all relevant studies, for example, Conrow, Campbell & Kingham (2021) show no change in active travel behaviour after the epidemic in New Zealand.

However, despite the increase in the average frequency of cycling, it is obvious that the majority never use cycling and the proportion of these people increases after the pandemic. In response to these findings, the interview data could explain why most respondents never cycle. All interviewees feel cycling in London is unsafe because of the lack of separation between cycle lanes and motorways and the high number of cars, and the need to look at the navigation due to not knowing the route also adds the risks of cycling. Some interviewees argue that for longer journeys, London's public transport system is more convenient and less time-consuming than cycling, while for shorter, walkable journeys they prefer walking to cycling. This is in line with the results of previous studies, where unlike other transport modes, the convenience of cycling decreases as the travel time increases, with cycling travel times even considered to be three times longer than other modes, leading to a negative effect on cycling (Heinen, Van Wee & Maat, 2010). Additionally, some respondents say that as international students they are only temporarily studying and living in London, so they will not buy a bike here and only consider cycling if there is easy access to bike-sharing facilities, but the availability of bike-sharing facilities close to their homes is minimal and the registration process is cumbersome. These are directly in line with the research by Abdullah et al. (2020) showing that even though people prefer safer travel modes after the pandemic, the shift from private cars to non-motorised vehicles after the pandemic is not evident in the current studies due to the lack of pedestrian and cycling infrastructure.

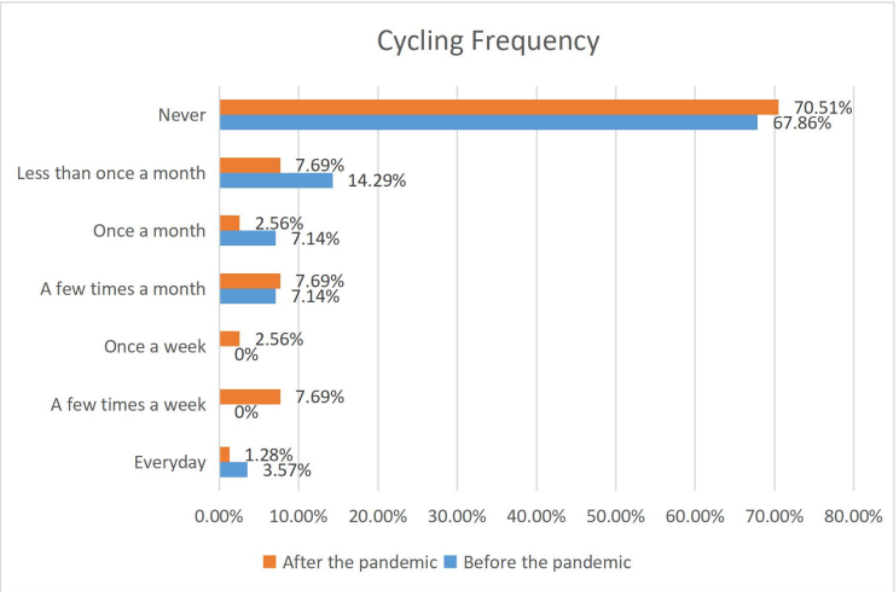

Figure 5: the cycling frequency before and after the pandemic (made by the author)

The key results of cycling purpose show that commuting to school is one of the main purposes both before and after the pandemic, and its share increases from just half to more than half. The other main purpose is transport, and the proportion of people cycling for transport demonstrates the biggest change, increasing from around a third to over half after the pandemic. In contrast, there is a decrease in purposes of recreation and sports and fitness. These findings suggest that young people cycle more for daily necessary purposes including commuting and transport and less for recreation and sports after the pandemic. Base on the literature (Laverty et al., 2020; De Vos, 2020; Hadjidemetriou et al., 2020), cycling, as one active travel mode, could be encouraged affected by the pandemic, as the public transport might be limited in the long term and people increase their awareness of the importance of active travel. Therefore, the possible reason of this finding is that some of those who used public transport modes for travel and transport before the epidemic have changed to cycle to reduce public transport as their mode of commuting and travel after the pandemic.

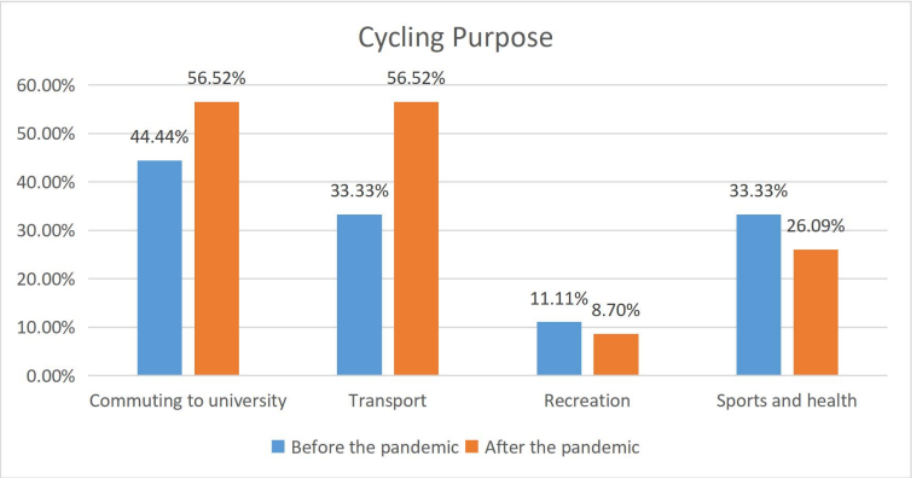

Figure 6: the cycling purpose before and after the pandemic (made by the author)

4.2 What are the determinants of cycling in young people's perceptions?

As table 1 shows, the importance of cycling factors at present and before the pandemic in young people's perceptions is ranked according to their mean value. Firstly, it is worth noting these interesting facts revealed by the results of top 6 determinants of cycling, in descending order of importance, including weather, travel distance, seasons and climate, infrastructure, topography, and perceived safety. They are the most important cycling factors for young people, as their high ranks remain unchanged whether there is an epidemic or not.

When discussing factors by category, natural environment factors are of high significance, as they are all in the top 6 determinants with the exception of daylight hours. Although the empirical study of Wang, Akar & Chen (2018) demonstrates that meteorological and weather factors have less influence on bike-sharing cycling behaviour among young millennials compared to older groups, from this study, weather still may largely influence cycling behaviour in young people's perceptions as

it ranks the first. Previous studies also confirm the significance of weather on people's cycling behaviour, specifically that bad weather including rain, cold, windy and unusual weather have negative impacts on cycling, while sunny and warm weather have positive impacts (Gao et al., 2018; Brandenburg, Matzarakis & Arnberger, 2004; Heinen, Van Wee & Maat, 2010; Fernández-Heredia, Monzón & Jara-Díaz, 2014). The influence of the third important factor, season and climate, is similar to the influence of weather, with studies showing that people cycle more in warmer summers and more pleasant climates, and less in colder winters and in places with colder climates (Heinen, Van Wee & Maat, 2010; Stinson & Bhat, 2004). For the fifth ranked topography, its significance for cycling has been widely proved in the literature, but whether it is negative or positive is debated. Heinen, Van Wee & Maat (2010) state that although hilly environments generally negatively affect cycling, they are preferred by experienced cyclists. The results of Fernández-Heredia, Monzón & Jara-Díaz (2014) also show a high mode share of cycling in some towns with unfavourable topography. On the other hand, the importance of daylight hours is relatively moderate (table 1), with the literature showing that darkness usually negatively affects cycling when sunlight hours are shortened (Gatersleben & Appleton, 2007).

The results also demonstrate the importance of trip factors (which involve the second ranked travel distance) on young people's cycling. Trip distance is one of key determinants for young people cycling as it ranked second important, and this is also reflected in the findings of interviews. Heinen, Van Wee & Maat (2010) confirm its significance and demonstrate that travel distance is usually negatively correlated with cycling, but also that some cyclists, for example for sports and health, may prefer long commuting trips. Traffic congestion and purpose are also relatively important factors, both ranking in the top 10 at present. The literature have studied their significant impacts respectively, stating that traffic congestion has similar effects on cycling as travel distance, increasing cycling time and effort and affecting positive attitudes to cycling (Gatersleben & Uzzell, 2007), and the purpose of the trip can also

lead to different preferences of cyclists (Nkurunziza, Van Maarseveen & Zuidgeest, 2010). However, contrary to above factors, travel costs become relatively less important as its ranking reduces significantly after the pandemic. This is also consistent with the findings of Abdullah et al. (2020), where the importance of perceived cost also decreases after the pandemic.

Among the built environment factors, urban form and urban greenery are relatively unimportant, with the exception of infrastructure, which is ranked fourth in importance. This demonstrates the high importance of infrastructure on young people's cycling, regardless of whether there is an epidemic or not. The interview findings also emphasis the importance of infrastructure for cycling, particularly safe and separated cycle lanes and convenient and available bike-sharing facilities, and the results of the literature (Heinen, Van Wee & Maat, 2010; Heesch, Giles- Corti & Turrell, 2015) are consistent with this, confirming that infrastructure such as cycling lanes, parking facilities and signs, traffic lights and the separation of bike lanes from traffic has significant impact on cycling. Its importance after the pandemic is also confirmed by Zafri et al. (2011) and Hong, McArthur & Raturi (2020). Besides, urban form, including population and address density, land use, building diversity and urban design, has been shown to have an impact on cycling in many empirical studies (Ewing & Cervero, 2010; Zahabi et al., 2016; Gao et al., 2018), but its importance ranking is in the middle position and does not reflect a high priority. Similar to this result, urban greenery is ranked relatively lower and is a less important factor comparing with others, contrary to Heesch, Giles-Corti & Turrell (2015) who argue that urban greenery is an important cycling factor.

As for psychological factors, the high importance of perceived safety (ranked 6th in this study) is also proved by the literature (Damant-Sirois & El-Geneidy, 2015; Heinen, Van Wee & Maat, 2010). It is also often cited in studies as a common reason why people do not choose to ride, as cycling is often perceived as less safe than other modes of transport (Heinen, Van Wee & Maat, 2010). Another relatively more

important psychological factor is perceived benefits of cycling, with its importance increasing significantly from 14th to 8th. In addition to them, preference for active travel, knowledge and perception of cycling routes, and habits and usual transport modes are all relatively important factors, ranking in the top 11 both before and after the pandemic. The impact of these factors related to perceptions and habits is confirmed by Willis, Manaugh & El-Geneidy (2015), and those who are used to cycling prior to the epidemic are more likely to increase their cycling trips under the new norm (Zafri et al., 2021). Other factors that improved the importance ranking are perceived risks of virus infection (ranking changed from 22nd to 17th) and willingness to go out (ranking changed from 16th to 14th), both of which have been associated with pandemic impact in the literature (Abdullah et al., 2020; Zafri et al., 2021). The remaining psychological factors are relatively less important, ranking lower than the 20th at present. The importance of both pro-environmental attitudes and perceived barriers to cycling drop to the bottom twentieth after the pandemic, contrary to the findings of Irawan, Bastarianto & Priyanto (2022) and Budi et al. (2021) which showing their importance after the pandemic. As for the factors related to TPB, only preference for active travel shows relatively high significance, while others (including pro-environment attitudes, ability/confidence to cycle and support of friends and family) show relatively low significance.

Table 1: the rank of importance of cycling factors at present and before the pandemic base on their mean value (made by the author)

Factors	At the present time		Before the pandemic		Rank changes after the pandemic
	Mean value	Rank	Mean value	Rank	
Built environment factors					
Urban form	3.45	13	3.31	16	3
Urban greenery	3.37	17	3.22	20	3
Infrastructure	3.77	4	3.76	4	0
Natural environment factors					
Weather	4.14	1	4.09	1	0
Topography	3.73	5	3.73	5	0
Season and climate	3.87	3	3.95	3	0
Daylight hours	3.41	14	3.46	11	-3
Trip factors					
Trip distance	4.03	2	3.99	2	0
Cost	3.36	19	3.45	13	-6
Travel purpose	3.64	7	3.46	11	4
Traffic congestion	3.60	9	3.63	7	-2
Psychological factors					
Preference for active travel	3.59	10	3.54	9	-1
Pro-environment attitudes	3.35	20	3.31	16	-4
Perceived benefits of cycling	3.63	8	3.40	14	6
Perceived barriers of cycling	3.28	21	3.31	16	-5
Ability/confidence to cycle	3.40	16	3.37	15	-1

Perceived safety	3.73	5	3.64	6	1
Knowledge and perception of cycling routes	3.58	11	3.50	10	-1
Perceived risks of virus infection	3.37	17	2.95	22	5
Willingness to go out	3.41	14	3.31	16	2
Habits of usual transport modes	3.58	11	3.55	8	-3
Support of friends and family	3.09	22	3.01	21	-1
Cycling behaviours of friends and family	3.05	23	2.91	23	0

4.3 How the determinants of cycling have changed after the pandemic in young people's perceptions?

Table 2 shows the results of the Wilcoxon signed-rank test to examine which factors changed significantly in importance after the pandemic and the respective rank changes in these factors after the pandemic. By comparing at the present time and before the pandemic, the changes in the importance of most factors are not significant, only the importance of travel purpose, perceived benefits of cycling, perceived risks of virus infection, and cycling behaviour of friends and family have changed significantly.

Among them, the rank of perceived benefits of cycling changes the most after the pandemic, from 14 to 8, demonstrating that its influence on cycling for young people increases significantly after the pandemic. According to the survey results of the open box questions, before the pandemic, respondents' perceived benefits of cycling include healthy, flexible, lower cost, environmental friendly, and recreational, while after the pandemic, outdoor and avoiding crowds are added. The results of the interviews also illustrate that respondents identify additional advantages of cycling after the outbreak and that these advantages lead to a greater willingness to cycle. The interviewees generally feel that cycling is safer than public transport in terms of pandemic prevention, with outdoor activities, less exposure to crowds and less susceptibility to infection emerging as perceived advantages of cycling as a result of pandemics. These increased perceived benefits are mainly related to infection, suggesting that cycling benefits related to infection prevention become more important after the pandemic, consistent with Abdullah et al. (2020) 's finding that people pay more attention to factors related to infection during the pandemic when choosing their mode of travel.

Perceived risks of virus infection, as the second major changed factor (its ranking increases from 22 to 17), are more involved in infection-related factors than perceived benefits of cycling after the pandemic. This result can be explained by existing research, confirming that people place high importance on infection-related factors such as wearing a mask, social distance, hygiene and risk of infection during the epidemic (Abdullah et al., 2020), and their perceived risk of virus transmission from cycling is negatively associated with cycling choice in the new norm (Zafri et al., 2021). The interview findings also demonstrate that respondents are more concerned about protection against viral infections after the epidemic, and that wearing masks, maintaining social distance and avoiding crowds become health benefits of cycling. However, it is worth noting that some interviewees feel they only reduced the use of public transport during the early stages of the outbreak, and are less concerned about the pandemic after they have already been infected. This can be explained by the results of Zafri et al. (2021), where those who perceive their immune system to be strong, have a carefree attitude, perceive a reduced risk of viral infection and are willing to go out will still choose their pre-pandemic travel patterns and are unlikely to increase their cycling in the new normal. Thus it is possible that in the future, as the results of the SARS and H1N1 virus studies have shown, the disruptive effects of pandemics on travel behaviour might only exist for the duration of the pandemic (Shakibaei et al., 2021).

After the pandemic, trip purpose becomes one of the important factors of cycling for young people as its importance rank increases from 11^{th} to 7^{th}. This result can be discussed together with the behaviour change findings of cycling purpose analyzed in this study (figure 6). The behavioural results indicate a decrease in cycling for recreational and sporting purposes and an increase in cycling for commuting and transportation among young people after the epidemic. A similar pattern of results is obtained in the study of Abdullah et al. (2020) on travel behaviour, showing that after the pandemic, the importance of travel purpose increases because it determines the regular and main trips performance, trip distance and mode choice, and the main

travel purpose changes by travelling more for necessary daily purposes including shopping, work and study and less for less important trips such as social, recreational and sporting. However, it is contrary to the findings of Hong, McArthur & Raturi (2020) on cycling in Glasgow, UK, which demonstrate a significant decrease in commuter trips and an increase in non-commuter trips after the pandemic, and people use cycling more as a form of exercise. None of these two studies focus on young population, but they are consistent with this thesis in the increase of the significance of travel purpose after the pandemic.

Although the importance of cycling behaviour of friends and family also shows significant change, it is relatively the least important in this study, ranking last both before and after the pandemic. Its impact on cycling after the pandemic is also missing in existing studies. Thus it is difficult to discuss the extent to which its importance to cycling has changed, and its impact may remain small after the pandemic. In this regard, the interviewees mention that when commuting and travelling with friends, if their friends change their transport mode and chose cycling, they would also change to cycle. A possible explanation for this finding could therefore be that the travel patterns of the interviewees' friends and family change after the epidemic, which may have influenced their mode choices.

Additionally, the literature shows that the importance of some cycling factors has also changed following the pandemic, but no significant changes in their importance are found in this study. For example, Budi et al., 2021 and Irawan, Bastarianto & Priyanto (2022) mention that pro-environment attitudes and climate change concerns increase after the pandemic, leading to negative attitudes towards vehicles and promoted cycling. Some more environmentally conscious interviewees explain that natural disasters like the pandemic increase their aware of environmental issues and positive attitudes to active travel, but they prefer walking rather than cycling. Besides, base on Abdullah et al. (2020), during the pandemic, travel cost is less concerned and might have less impact on cycling, and trip distance is shorten.

Willingness to go out and rest from family activities also became one of the main drivers of active travel after the embargo period (Conrow, Campbell & Kingham, 2021; Zafri et al., 2021). They all have the potential to alter the impact on cycling, but we did not find this in the results. This may be due to the fact that this study targeted a specific group of young university students in London, whereas these previous studies were conducted on the general population. It is also important to note that the majority of respondents in this study never cycle, which may causes them to focus on different factors than cyclists.

Table 2: Results of Wilcoxon signed-rank test for changes in the importance of cycling factors from pre-pandemic to at present, and changes in their mean value rank (made by the author)

Factor	Wilcoxon signed-rank test		Rank changes after the pandemic
	Test statistic	p-value	
Built environment factors			
Urban form	-1.807	.071	3
Urban greenery	-1.833	.067	3
Infrastructure	-.357	.721	0
Natural environment factors			
Weather	-1.265	.206	0
Topography	.000	1.000	0
Season and climate	-1.017	.309	0
Daylight hours	-1.006	.314	-3
Trip factors			
Trip distance	-.656	.512	0
Cost	-1.262	.207	-6
Travel purpose	-2.183	.029	4
Traffic congestion	-.423	.672	-2
Psychological factors			
Preference for active travel	-.751	.453	-1
Pro-environment attitudes	-.539	.590	-4
Perceived benefits of cycling	-2.416	.016	6
Perceived barriers of cycling	-.390	.696	-5
Ability/confidence to cycle	-.593	.553	-1
Perceived safety	-1.384	.166	1

Knowledge and perception of cycling routes	-1.108	.268	-1
Perceived risks of virus infection	-2.670	.008	5
Willingness to go out	-1.009	.313	2
Habits of usual transport modes	-.393	.694	-3
Support of friends and family	-1.269	.204	-1
Cycling behaviour of friends and family	-2.399	.016	0

CHAPTER 5 Conclusion

Returning to the research questions posed, for the determinants of cycling, based on a literature review this paper examines built environment factors, natural environment factors, trip factors, and psychological factors. The most important determinants of cycling perceived by young people remain the same regardless of the pandemic, namely weather, trip distance, season and climate, infrastructure, topography, and perceived safety. They are needed to be concerned in future research and transport planning measures to promote cycling for young people.

As for changes in young people's cycling behaviour after the pandemic, similar to common findings in the literature, the usual travel modes of young people change, with a decline in the use of public transport and an increase in the use of other modes including cycling, taxi/Uber, and walking. Their average frequency of cycling also increases after the pandemic. However, regardless of the pandemic, most young people never cycle in London due to the lack of safe, separated cycling lanes, unfamiliarity with roads, and the lack of bike-sharing facilities. From their perspective, building safe, separated, accessible cycle lanes that connect important places and providing convenient bike-sharing facilities would encourage them to choose to cycle here. Also, the purpose of cycling among younger cyclists changes after the pandemic, with an increase in daily trips for commuting and transport and a decrease in relatively unimportant recreational and sporting trips. This is not entirely consistent with the literature, as the results on the purpose of travel have just not been consistent in previous studies.

The only cycling factors that changed significantly in importance for young people after the epidemic are travel purpose, perceived benefits of cycling, perceived risks of virus infection, and cycling behaviour of friends and family. With the exception of cycling behaviour of friends and family, all of their importance ranks increase after the pandemic. The importance of perceived benefits of cycling and perceived risks of

virus infection as factors related to protection from infection also increases after the pandemic. Cycling behaviour of friends and family ranks the lowest in importance and its post-epidemic impact is not mentioned in the literature, so it is possible that its impact on cycling remained small in the post-epidemic period.

5.1 Recommendations

As a highly mobile and large group of people, young people in London, particularly the international university students, are critical in promoting a decarbonised transport transition in London. Based on this study and previous literature, it is clear that after the pandemic, young people place greater emphasis on factors related to infection protection and use public transport less, which presents opportunities for active travel modes such as cycling. The benefits of cycling during an epidemic in terms of avoiding crowds and the relatively lower risk of virus infection should also be promoted. However, in the new normal some young people already pay less attention on protection from infection and start to use their pre-pandemic travel patterns again, and past experience with other viral pandemics also suggests that the disruption to people's travel patterns from the pandemic is short-term (Shakibaei et al., 2021). Therefore, policymakers should seize the opportunity during the pandemic and take early steps to increase young people's cycling in the new normal and even in the future, when the epidemic is over. During the pandemic, cycling infrastructure has been invested by different countries around the world to support active travel, and these measures' s effect needs to be permanent, so transport planners still need additional policy measures to sustain interest in active travel beyond the pandemic (Zafri et al., 2021).

Most international students in London do not cycle, and the lack of separated, well-connected cycle lanes and accessible bike-sharing facilities in London is a major deterrent to cycling. Given the distance travelled, infrastructure, and perceived safety

as their perceived determinants of cycling, London's transport planners and government, in an effort to attract more international students to cycle, should prioritize the creation of separate and safe cycle lanes that are well connected and away from heavy traffic and provide a variety of bike-sharing facilities across the city to make cycling safer and more convenient. Besides, the purpose of cycling for younger cyclists has shifted more towards commuting and transport on a daily basis after the pandemic. Improving or creating cycling infrastructure with access to schools and key locations is therefore also a potential measure to increase cycling among young people. Hong, McArthur & Raturi (2020) demonstrate that connections to amenities and attractions should be considered when planning cycling infrastructure, and the provision of temporary cycle paths during the pandemic might promote cycle.

5.2 Limitations and areas for further research

There are some limitations to this thesis and some areas for further research that need to be pointed out. Firstly, the sample size was too small and homogenous as the data was collected through an online survey to my friends. Therefore the sample cannot represent all groups of young Londoners and it might be impractical to generalise the results for all young people. This should be tested in future research with a larger sample size and a more diverse and representative group. Second, although the sample was international university students, this study did not explore international cultural backgrounds in relation to cycling behaviour and perceptions, so research on national cultural backgrounds and cycling behaviour could also be added to future studies. Third, some of the respondents had only lived in London for one year at postgraduate level and had not visited London before the pandemic. Thus it is not possible to examine changes in their travel behaviour in London before and after the pandemic, which could only be analyzed through the proportion change in this study, and differences in sample size may affect the accuracy of the

results. Thirdly, some respondents had only lived in London for one year and had not visited London before the pandemic. It was therefore not possible to examine changes in their travel behaviour before and after the pandemic. In this study, it was analysed through changes in proportions, but differences in sample size may affect the accuracy of the results. Besides, as all interviewees never cycled in London, the interview results missed the views of cyclists who may have different travel behaviours and perceptions. The investigation of determinants only reflected their perceptions, so the correlation between cycling factors and behaviour were still needed to be studied in future empirical studies. However, it is also likely that the surveyed behaviour is not truly representative of the actual travel behaviour of the respondents. Additionally, due to the homogeneity and small size of the sample, the socio-demographic factors was only used as basic information and its relationship with cycling behaviour was not analysed. As the links between socio-demographic and cycling have been widely studied in the literature, future studies should be conducted when the sample is larger and more diverse to study these factors. Nevertheless, the results of this study may have implications for cycling planning in the post-epidemic era or the new normal. In the future the epidemic will become increasingly normalised, and the role of long-term post-epidemic changes in young people's cycling behaviour, perceptions, and the effect of implemented measures will continue to require ongoing attention. What kind of interventions are effective in promoting cycling is also worth being studied, which can be combined with policy research for other cycling-led cities.

Bibliography

Abdullah, M., Dias, C., Muley, D., & Shahin, M. (2020). Exploring the impacts of COVID-19 on travel behavior and mode preferences. *Transportation research interdisciplinary perspectives*, *8*, 100255.

Acheampong, R. A. (2017). Towards sustainable urban transportation in Ghana: exploring adults' intention to adopt cycling to work using theory of planned behaviour and structural equation modelling. *Transportation in developing economies*, *3*(2), 1-11.

Ajzen I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211.

Akar, G., & Clifton, K. J. (2009). Influence of individual perceptions and bicycle infrastructure on decision to bike. *Transportation research record*, *2140*(1), 165-172.

Akar, G., Fischer, N., & Namgung, M. (2013). Bicycling choice and gender case study: The Ohio State University. *International journal of sustainable transportation*, *7*(5), 347-365.

Bamberg, S., Ajzen, I., & Schmidt, P. (2003). Choice of travel mode in the theory of planned behavior: The roles of past behavior, habit, and reasoned action. *Basic and applied social psychology*, *25*(3), 175-187.

Basaran, G. G., Kristoffersen, D., Haustein, S., & Başaran, G. G. (2021). Safety Perceptions and Cycling Frequency of Highly Educated Young People Who Grew Up in Different Mobility Cultures. *Active Travel Studies*, *1*(1).

Beck, M.J., Hensher, D.A. (2020) Insights into the impact of COVID-19 on household

travel and activities in Australia—The early days of easing restrictions. *Transp. Policy*, *99*, 95–119.

Bergström, A. & Magnussen, R. (2003). Potential of transferring car trips to bicycle during winter. *Transportation Research Part A*, 37: 649–666.

Blumenberg, E., Taylor, B. D., Smart, M., Ralph, K., Wander, M., & Brumbagh, S. (2012). What's Youth Got to Do with It? Exploring the Travel Behavior of Teens and Young Adults.

Brandenburg, C., Matzarakis, A., & Arnberger, A. (2004). The effects of weather on frequencies of use by commuting and recreation bicyclists. *Advances in tourism climatology*, *12*, 189-197.

Brunton, G., Oliver, S., Oliver, K., & Lorenc, T. (2006). A synthesis of research addressing children's, young people's and parents views of walking and cycling for transport.

Bucsky, P. (2020). Modal share changes due to COVID-19: The case of Budapest. *Transportation Research Interdisciplinary Perspectives*, *8*, 100141.

Budi, D. R., Widyaningsih, R., Nur, L., Agustan, B., Dwi, D. R. S., Qohhar, W., & Asnaldi, A. (2021). Cycling during covid-19 pandemic: Sports or lifestyle. *International Journal of Human Movement and Sports Sciences*, *9*(4), 765-771.

Buehler, R., & Pucher, J. (2021). COVID-19 impacts on cycling, 2019–2020. *Transport Reviews*, *41*(4), 393-400.

Conrow, L., Campbell, M., & Kingham, S. (2021). Transport changes and COVID-19: From present impacts to future possibilities. *New Zealand Geographer*, *77*(3),

185-190.

Corner, A., Roberts, O., Chiari, S., Völler, S., Mayrhuber, E. S., Mandl, S., & Monson, K. (2015). How do young people engage with climate change? The role of knowledge, values, message framing, and trusted communicators. *Wiley Interdisciplinary Reviews: Climate Change*, *6*(5), 523-534.

Damant-Sirois, G., & El-Geneidy, A. M. (2015). Who cycles more? Determining cycling frequency through a segmentation approach in Montreal, Canada. *Transportation Research Part A: Policy and Practice*, *77*, 113-125.

de Bruijn, G. J., Kremers, S. P., Singh, A., Van den Putte, B., & Van Mechelen, W. (2009). Adult active transportation: adding habit strength to the theory of planned behavior. *American journal of preventive medicine*, *36*(3), 189-194.

De Vos, J. (2020). The effect of COVID-19 and subsequent social distancing on travel behavior. *Transportation Research Interdisciplinary Perspectives*, *5*, 100121.

Deng, Y., Wang, M., & Yousefpour, R. (2017). How do people's perceptions and climatic disaster experiences influence their daily behaviors regarding adaptation to climate change?—A case study among young generations. *Science of the total environment*, *581*, 840-847.

Dill, J., & Voros, K. (2007). Factors affecting bicycling demand: initial survey findings from the Portland, Oregon, region. *Transportation research record*, *2031*(1), 9-17.

Drezner, Z., & Turel, O. (2011). Normalizing variables with too-frequent values using a Kolmogorov–Smirnov test: A practical approach. *Computers & Industrial Engineering*, *61*(4), 1240-1244.

Etminani-Ghasrodashti, R., Paydar, M., & Hamidi, S. (2018). University-related travel behavior: Young adults' decision-making in Iran. *Sustainable cities and society*, *43*, 495-508.

Ewing, R. & Cervero, R. (2001). Travel and the built environment: a synthesis. *Transportation Research Record*, 1780: 87–114.

Fernández-Heredia, Á., Monzón, A., & Jara-Díaz, S. (2014). Understanding cyclists' perceptions, keys for a successful bicycle promotion. *Transportation research part A: policy and practice*, *63*, 1-11.

Gao, J., Kamphuis, C., Dijst, M., & Helbich, M. (2018). The role of the natural and built environment in cycling duration in the Netherlands. *International journal of behavioral nutrition and physical activity*, *15*(1), 1-16.

Garrison, C. (2015). Livable neighborhood factors affecting mode choices in a medium sized university community.

Gatersleben, B. & Appleton, K. M. (2007). Contemplating cycling to work: attitudes and perceptions in different stages of change. *Transportation Research Part A*, 41(4): 302–312.

Gatersleben, B. & Uzzell, D. (2007). Affective appraisals of the daily commute: comparing perceptions of drivers, cyclist, and users of public transport. *Environment and Behavior*, 39(5): 416–431.

George, A. L., & Bennett, A. (2005). *Case studies and theory development in the social sciences*. mit Press.

Gray, P. S., Williamson, J. B., Karp, D. A., & Dalphin, J. R. (2007). *The research*

imagination: An introduction to qualitative and quantitative methods. Cambridge University Press.

Green, J., & Thorogood, N. (2018). *Qualitative methods for health research*. sage.

Hadjidemetriou, G. M., Sasidharan, M., Kouyialis, G., & Parlikad, A. K. (2020). The impact of government measures and human mobility trend on COVID-19 related deaths in the UK. *Transportation research interdisciplinary perspectives*, *6*, 100167.

Handy, S. L., & Xing, Y. (2011). Factors correlated with bicycle commuting: A study in six small US cities. *International Journal of Sustainable Transportation*, *5*(2), 91-110.

Heesch, K. C., Giles-Corti, B., & Turrell, G. (2014). Cycling for transport and recreation: associations with socio-economic position, environmental perceptions, and psychological disposition. *Preventive medicine*, *63*, 29-35.

Heesch, K. C., Giles-Corti, B., & Turrell, G. (2015). Cycling for transport and recreation: associations with the socio-economic, natural and built environment. *Health & place*, *36*, 152-161.

Heinen, E., Van Wee, B., & Maat, K. (2010). Commuting by bicycle: an overview of the literature. *Transport reviews*, 30(1), 59-96.

Hidalgo-González, C., Rodríguez-Fernández, M. P., & Pérez-Neira, D. (2022). Energy consumption in university commuting: Barriers, policies and reduction scenarios in León (Spain). *Transport Policy*, *116*, 48-57.

Hoffman, J. (2015). Chapter 22-Comparison of two groups: t-tests and nonparametric tests. *Biostatistics for medical and biomedical practitioners*, 337-362.

Hong, J., McArthur, D., & Raturi, V. (2020). Did safe cycling infrastructure still matter during a COVID-19 lockdown?. *Sustainability*, *12*(20), 8672.

Hopkins, D., & Stephenson, J. (2014). Generation Y mobilities through the lens of energy cultures: a preliminary exploration of mobility cultures. *Journal of Transport Geography*, *38*(1), 88-91.

Huq, S., & Toulmin, C. (2006). Three eras of climate change.

Intelligent Transport (2020). TfL to expand Satander Cycles scheme amid demand boom. [Online] Available from: https://www.intelligenttransport.com/transport-news/100644/tfl-to-expand-satander-cycles-scheme-amid-demand-boom/ (Accessed: 27 July 2022)

Irawan, M. Z., Bastarianto, F. F., & Priyanto, S. (2022). Using an integrated model of TPB and TAM to analyze the pandemic impacts on the intention to use bicycles in the post-COVID-19 period. *IATSS Research*.

Jiao, J., & Azimian, A. (2021). Exploring the factors affecting travel behaviors during the second phase of the COVID-19 pandemic in the United States. *Transportation Letters*, *13*(5-6), 331-343.

Kwon, H. R., & Silva, E. A. (2020). Mapping the landscape of behavioral theories: Systematic literature review. *Journal of Planning Literature*, 35(2), 161-179.

Laverty, A. A., Millett, C., Majeed, A., & Vamos, E. P. (2020). COVID-19 presents opportunities and threats to transport and health. *Journal of the Royal Society of Medicine*, *113*(7), 251-254.

Li, H., Zhang, Y., Zhu, M., & Ren, G. (2021). Impacts of COVID-19 on the usage of

public bicycle share in London. *Transportation Research Part A: Policy and Practice*, *150*, 140-155.

Liu, Y., Sheng, H., Mundorf, N., Redding, C., & Ye, Y. (2017). Integrating Norm Activation Model and Theory of Planned Behavior to Understand Sustainable Transport Behavior: Evidence from China. *International Journal of Environmental Research and Public Healt*h, 14(12), 1593–. https://doi.org/10.3390/ijerph14121593

London Higher (2019) LONDON HIGHER FACTSHEET 2019, STUDENTS IN HIGHER EDUCATION 2017/18. [Online] Available from: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjQhODssJ76AhWDhFwKHXgwB5wQFnoECAQQAQ&url=https%3A%2F%2Fwww.londonhigher.ac.uk%2Fwp-content%2Fuploads%2F2019%2F04%2FLdnHigher_AltProviders2019.pdf&usg=AOvVaw33KPoQN6zjk3ZuYtCFbJbh (Accessed: 25 April 2022)

Lune, H., & Berg, B. L. (2017). *Qualitative research methods for the social sciences*. Pearson.

Mitra, R., & Nash, S. (2019). Can the built environment explain gender gap in cycling? An exploration of university students' travel behavior in Toronto, Canada. *International journal of sustainable transportation*, *13*(2), 138-147.

Mohajan, H. K. (2018). Qualitative research methodology in social sciences and related subjects. *Journal of Economic Development, Environment and People*, *7*(1), 23-48.

Mohammed, A. M., Ukai, T., & Hall, M. (2022). Towards a sustainable campus-city relationship: A systematic review of the literature. *Regional Sustainability*, *3*(1), 53-67.

Morris, J., Marzano, M., Dandy, N., & O'Brien, L. (2012). Theories and models of behaviour and behaviour change. *Forest Research: Surrey, United Kingdom*, 1-27.

Newbold, K. B., & Scott, D. M. (2017). Driving over the life course: the automobility of Canada's millennial, generation X, baby boomer and greatest generations. *Travel Behaviour and Society*, *6*, 57-63.

Nikitas, A., Tsigdinos, S., Karolemeas, C., Kourmpa, E., & Bakogiannis, E. (2021). Cycling in the era of COVID-19: Lessons learnt and best practice policy recommendations for a more bike-centric future. *Sustainability*, *13*(9), 4620.

Nkurunziza, A., Van Maarseveen, M. F. A. M., & Zuidgeest, M. H. P. (2010). Cycling potential demand and travel behavour change in Dar-Es-Salaam, Tanzania. In *12th World Conference on Transport Research, WCTR 2010* (pp. 1-21). WCTR Society.

O'Malley, J. (2021). On yer bike: Since Covid-19 first hit, London has almost doubled the amount of segregated cycling infrastructure and created dozens of'low traffic neighbourhoods'. *Engineering & Technology*, *16*(3), 52-55.

Panter, J. R., & Jones, A. (2010). Attitudes and the environment as determinants of active travel in adults: what do and don't we know?. *Journal of Physical Activity and Health*, *7*(4), 551-561.

Polzin, S. E., Chu, X., & Godfrey, J. (2014). The impact of millennials' travel behavior on future personal vehicle travel. *Energy Strategy Reviews*, *5*, 59-65.

Pucher, J., & Buehler, R. (2012). Promoting cycling for daily travel: Conclusions and lessons from across the globe. *City cycling*, 347-363.

Robertson-Wilson, J. E., Leatherdale, S. T., & Wong, S. L. (2008). Social–ecological correlates of active commuting to school among high school students. *Journal of Adolescent Health*, *42*(5), 486-495.

Sallis, J. F., Owen, N., & Fisher, E. (2015). Ecological models of health behavior. *Health behavior: Theory, research, and practice*, *5*(43-64).

Shakibaei, S., De Jong, G. C., Alpkökin, P., & Rashidi, T. H. (2021). Impact of the COVID-19 pandemic on travel behavior in Istanbul: A panel data analysis. *Sustainable cities and society*, *65*, 102619.

Sirard, J. R., & Slater, M. E. (2008). Walking and bicycling to school: a review. *American Journal of Lifestyle Medicine*, *2*(5), 372-396.

Sottile, E., Tuveri, G., Piras, F., & Meloni, I. (2022). Modelling commuting tours versus non-commuting tours for university students. A panel data analysis from different contexts. *Transport Policy*.

Steckler, A., McLeroy, K. R., Goodman, R. M., Bird, S. T., & McCormick, L. (1992). Toward integrating qualitative and quantitative methods: an introduction. *Health education quarterly*, *19*(1), 1-8.

Stinson, M. A. & Bhat, C. R. (2004). Frequency of bicycle commuting: internet-based survey analysis. *Transportation Research Record*, 1878: 122–130.

Swiers, R., Pritchard, C., & Gee, I. (2017). A cross sectional survey of attitudes, behaviours, barriers and motivators to cycling in University students. *Journal of Transport & Health*, *6*, 379-385.

Titze, Stronegger, W. J., Janschitz, S., & Oja, P. (2007). Environmental, social, and

personal correlates of cycling for transportation in a student population. *Journal of Physical Activity & Health*, 4(1), 66–79. https://doi.org/10.1123/jpah.4.1.66

Wang, K., Akar, G., & Chen, Y. J. (2018). Bike sharing differences among millennials, Gen Xers, and baby boomers: Lessons learnt from New York City's bike share. *Transportation research part A: policy and practice*, *116*, 1-14.

Whalen, K. E., Páez, A., & Carrasco, J. A. (2013). Mode choice of university students commuting to school and the role of active travel. *Journal of Transport Geography*, *31*, 132-142.

Willis, D. P., Manaugh, K., & El-Geneidy, A. (2015). Cycling under influence: summarizing the influence of perceptions, attitudes, habits, and social environments on cycling for transportation. *International Journal of Sustainable Transportation*, *9*(8), 565-579.

Wong, B. Y. M., Faulkner, G., & Buliung, R. (2011). GIS measured environmental correlates of active school transport: a systematic review of 14 studies. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 1-22.

Xia, Y. (2020). Correlation and association analyses in microbiome study integrating multiomics in health and disease. *Progress in Molecular Biology and Translational Science*, *171*, 309-491.

Yang, Y., Wu, X., Zhou, P., Gou, Z., & Lu, Y. (2019). Towards a cycling-friendly city: An updated review of the associations between built environment and cycling behaviors (2007–2017). *Journal of Transport & Health*, *14*, 100613.

Zafri, N. M., Khan, A., Jamal, S., & Alam, B. M. (2021). Impacts of the COVID-19 pandemic on active travel mode choice in Bangladesh: a study from the perspective

of sustainability and new normal situation. *Sustainability*, *13*(12), 6975.

Zahabi, S. A. H., Chang, A., Miranda-Moreno, L. F., & Patterson, Z. (2016). Exploring the link between the neighborhood typologies, bicycle infrastructure and commuting cycling over time and the potential impact on commuter GHG emissions. *Transportation research part D: transport and environment*, *47*, 89-103.

Appendix 1: Data table

Table: Results of mean, standard deviation and Kolmogorov-Smirnov test of normality for the changes in perceived importance of cycling factors between at present and before the pandemic.

Factor		Mean	Standard deviation	Kolmogorov-Smirnov Test	
				test statistic	p-value
Neighborhood environment	Current	3.45	.962	.306	<.001
	Before	3.31	.997	.231	<.001
Urban greenery	Current	3.37	1.070	.298	<.001
	Before	3.22	1.015	.254	<.001
Infrastructure	Current	3.77	1.139	.247	<.001
	Before	3.76	1.071	.257	<.001
Weather	Current	4.14	1.041	.257	<.001
	Before	4.09	1.047	.244	<.001
Topography	Current	3.73	1.015	.207	<.001
	Before	3.73	.949	.201	<.001
Season and climate	Current	3.87	1.073	.265	<.001
	Before	3.95	.979	.264	<.001
Daylight hours	Current	3.41	1.156	.195	<.001
	Before	3.46	1.089	.215	<.001
Trip distance	Current	4.03	.868	.257	<.001
	Before	3.99	.890	.211	<.001
Cost	Current	3.36	1.006	.191	<.001
	Before	3.45	.962	.204	<.001
Travel purpose	Current	3.64	.967	.247	<.001
	Before	3.46	1.053	.234	<.001
Traffic congestion	Current	3.60	.843	.271	<.001

	Before	3.63	.839	.287	<.001
Preference for active travel	Current	3.59	.889	.229	<.001
	Before	3.54	.833	.241	<.001
Pro-environment attitudes	Current	3.35	1.004	.204	<.001
	Before	3.31	.971	.211	<.001
Perceived benefits of cycling	Current	3.63	.913	.261	<.001
	Before	3.40	.944	.213	<.001
Perceived barriers of cycling	Current	3.28	1.138	.223	<.001
	Before	3.31	1.132	.217	<.001
Ability/confidence to cycle	Current	3.40	1.132	.241	<.001
	Before	3.37	1.141	.209	<.001
Perceived safety	Current	3.73	.989	.261	<.001
	Before	3.64	1.019	.266	<.001
Knowledge and perception of cycling routes	Current	3.58	.961	.221	<.001
	Before	3.50	1.029	.199	<.001
Perceived risks of virus infection	Current	3.37	1.141	.222	<.001
	Before	2.95	1.278	.218	<.001
Willingness to go out	Current	3.41	1.037	.241	<.001
	Before	3.31	1.010	.228	<.001
Habits of usual transport modes	Current	3.58	.947	.249	<.001
	Before	3.55	1.015	.261	<.001
Support of friends and family	Current	3.09	1.095	.194	<.001
	Before	3.01	1.013	.213	<.001
Cycling behaviours of friends and family	Current	3.05	1.005	.225	<.001
	Before	2.91	1.009	.189	<.001

Appendix 2: Questionnaire design

A Study on Young People's Behaviours and Determinants of Cycling in Post-Pandemic London

Hi! This is Chuyao. I am an MSc Sustainable Urbanism student at University College London (UCL). Before you decide whether to participate in this survey, it is important for me to inform you of the purpose of the study and what it involves. This research aims to study young people's behaviours and determinants of cycling in post-pandemic London. By completing this survey, you are giving your consent for your responses to be used in this research. As a young person in my research area, your ideas are invaluable to my research.
This study is anonymous. You can look back at your responses or stop completing the questionnaire at any time you wish. If you would like to participate in this study, please answer the following questions.

*Please only answer this questionnaire if you are a university student living in London.

Part 1: Socio-demographic information & cycling behaviour

1. What is your gender? [Single choice] *

oMale

oFemale

oPrefer not to say

oOthers _____

2. What is your age? [open box] *

_____

3. What is your educational level? [Single choice] *

oBachelor

oMaster

oPhD

○Others _____ *

4. Do you own a car/bicycle? [Single choice] *

○Yes, I own a car.

○Yes, I own a bicycle

○I don't own a car or a bicycle.

5. Where are you from? [Single choice] *

○London

○UK cities other than London

○Other countries _____ *

6. How long have you lived in the UK and what city did you live in? [open box] *

_____

7. Have you been to London before the pandemic? [Single choice] *

○Yes

○No

8. What is your usual transportation mode in London? [multiple choices] *

□Walking

□Cycling

□E-bike/motorcycle

□Bus

□Metro

□Taxi/uber

□Private car

□Others _____*

9. What was your usual transportation mode in London before the pandemic? [multiple choices]

*

□Walking

□Cycling

□E-bike/motorcycle

□Bus

□Metro

□Taxi/uber

□Private car

□Others _____*

10. How often do you cycle in London? [Single choice] *

○Everyday

○A few times a week

○Once a week

○A few times a month

○Once a month

○Less than once a month

○Never

11. How often did you cycle in London before the pandemic? [Single choice] *

○Everyday

○A few times a week

○Once a week

○A few times a month

○Once a month

○Less than once a month

○Never

12. What is your purpose of cycling in London? [multiple choices] *

□Commuting to university

□Transport

□Recreation

□Sports and health

□Others _____*

13. What was your purpose of cycling before the pandemic? [multiple choices] *

□Commuting to university

□Transport

□Recreation

□Sports and health

□Others _____*

Part 2: Determinants of cycling

14. How important are the following factors to you as it pertains to cycling at the present time and before the pandemic?[5-Likert Scale] *

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Built environment factors					

At the present time: Urban form (building diversity, land use, population and address density, urban design)	o	o	o	o	o
Before the pandemic: Urban form	o	o	o	o	o
At the present time: Urban greenery (e.g. number of green spaces, exist of street trees)	o	o	o	o	o
Before the pandemic: Urban greenery	o	o	o	o	o
At the present time: Infrastructure (separate cycling lanes, paths, parking facilities and signs, traffic lights, short distance to cycle lanes)	o	o	o	o	o
Before the pandemic:	o	o	o	o	o

Infrastructure					
Natural environment factors					
At the present time: Weather (e.g. rain, sun, wind, unusual weather, temperature)	o	o	o	o	o
Before the pandemic: Weather	o	o	o	o	o
At the present time: Topography (e.g. plain, hilly)	o	o	o	o	o
Before the pandemic: Topography	o	o	o	o	o
At the present time: Season and climate	o	o	o	o	o
Before the pandemic: Season and climate	o	o	o	o	o
At the present time: Daylight hours	o	o	o	o	o
Before the pandemic: Daylight hours	o	o	o	o	o

Trip factors					
At the present time: Trip distance	o	o	o	o	o
Before the pandemic: Trip distance	o	o	o	o	o
At the present time: Cost	o	o	o	o	o
Before the pandemic: Cost	o	o	o	o	o
At the present time: Travel purpose (e.g. commuting, recreation, sports)	o	o	o	o	o
Before the pandemic: Travel purpose	o	o	o	o	o
At the present time: Traffic congestion	o	o	o	o	o
Before the pandemic: Traffic congestion	o	o	o	o	o
Psychological and social factors					
At the present time: Preference for	o	o	o	o	o

active travel (cycling and walking)					
Before the pandemic: Preference for active travel	o	o	o	o	o
At the present time: Pro-environment attitudes (e.g. awareness of environment and climate change)	o	o	o	o	o
Before the pandemic: Pro-environment attitudes	o	o	o	o	o
At the present time: Perceived benefits of cycling (e.g. avoiding crowds, outdoor, healthy, cheap, convenient, fast, environment-friendly, flexible)	o	o	o	o	o
Before the pandemic:	o	o	o	o	o

Perceived benefits of cycling (e.g. healthy, cheap, convenient, fast, environment-friendly, flexible)					
At the present time: Perceived barriers of cycling (e.g. lack of skills, physical discomfort)	o	o	o	o	o
Before the pandemic: Perceived barriers of cycling	o	o	o	o	o
At the present time: Ability/confidence to cycle	o	o	o	o	o
Before the pandemic: Ability/confidence to cycle	o	o	o	o	o
At the present time: Perceived safety (e.g. concern about traffic safety, safety from bicycle theft)	o	o	o	o	o

Before the pandemic: Perceived safety	o	o	o	o	o
At the present time: Knowledge and perception of cycling routes	o	o	o	o	o
Before the pandemic: Knowledge and perception of cycling route	o	o	o	o	o
At the present time: Perceived risks of virus infection (e.g. social distance, wearing a mask, avoiding the crowds)	o	o	o	o	o
Before the pandemic: Perceived risks of virus infection	o	o	o	o	o
At the present time: Willingness to go out	o	o	o	o	o
Before the	o	o	o	o	o

pandemic: Willingness to go out					
At the present time: Habits of usual transport modes	o	o	o	o	o
Before the pandemic: Habits of usual transport modes	o	o	o	o	o
At the present time: Support of friends and family	o	o	o	o	o
Before the pandemic: Support of friends and family	o	o	o	o	o
At the present time: Cycling behaviours of friends and family	o	o	o	o	o
Before the pandemic: Cycling behaviours of friends and family	o	o	o	o	o

15. [OPTIONAL] Why do you think these factors could influence your cycling? How have your views changed compared to before the epidemic? You could explain your reasons and changes, or provide any comments/additions here. [open box]

_____

16. [OPTIONAL] If you are interested in my research and would like a follow-up interview with me, please leave your contact details here. (Could be your email address/Wechat/Whatsapp etc). [open box]

_____

Appendix 3: Semi-structured interview questions

Has the outbreak affected the way you travel? How has your usual transport mode changed since the pandemic? Why?

Why you never cycle in London? What circumstances would make you more likely to cycle here?

What are the determinants for your cycling?

What cycling factors have changed in importance for you after the pandemic and why?

Ethical Clearance questionnaire responses

Ethical Clearance Pro Forma

It is important for you to include all relevant information about your research in this form, so that your supervisor can give you the best advice on how to proceed with your research.

You are advised to read though the relevant sections of UCL's Research Integrity guidance to learn more about your ethical obligations.

Submission Details

1. **Name of programme of study:**

   MSc Sustainable Urbanism

2. **Please indicate the type of research work you are doing (Delete that which do not apply):**

- Dissertation in Planning (MSc)

3. **Please provide the current working title of your research:**

   A Study on Young People’ s Behaviours and Determinants of Cycling in Post-Pandemic London

4. **Please indicate your supervisor’s name:**

   Andres, Lauren

Research Details

5. **Please indicate here which data collection methods you expect to use. (Tick all that apply/or delete those which do not apply.)**

- Interviews
- Questionnaires (including oral questions)
- Documentary analysis (including use of personal records)
- Intervention study (including changing environments)

6. **Please indicate where your research will take place (delete that which does not apply):**

- UK only

7. **Does your project involve the recruitment of participants?**
   'Participants' means human participants and their data (including sensor/locational data and observational notes/images.)

   Yes

Appropriate Safeguard, Data Storage and Security

8. Will your research involve the collection and/or use of personal data?

Personal data is data which relates to a living individual who can be identified from that data or from the data and other information that is either currently held, or will be held by the data controller (you, as the researcher).

This includes:

- Any expression of opinion about the individual and any intentions of the data controller or any other person toward the individual.
- Sensor, location or visual data which may reveal information that enables the identification of a face, address etc. (some post codes cover only one property).
- Combinations of data which may reveal identifiable data, such as names, email/postal addresses, date of birth, ethnicity, descriptions of health diagnosis or conditions, computer IP address (of relating to a device with a single user).

Yes

9. Is your research using or collecting:

- special category data as defined by the General Data Protection Regulation*, and/or
- data which might be considered sensitive in some countries, cultures or contexts?

*Examples of special category data are data:

- which reveals racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership;
- concerning health (the physical or mental health of a person, including the provision of health care services);
- concerning sex life or sexual orientation;
- genetic or biometric data processed to uniquely identify a natural person.

Yes

10. Do you confrm that all personal data will be stored and processed in compliance with the General Data Protection Regulation (GDPR 2018)? (Choose one only, delete that which does not apply)

Yes

11. I confirm that:

- The information in this form is accurate to the best of my knowledge.
- I will continue to reflect on and update these ethical considerations in consultation with my supervisor.

Yes

UCL risk assessment form

RISK ASSESSMENT FORM
FIELD / LOCATION WORK

DEPARTMENT/SECTION: BARTLETT SCHOOL OF PLANNING

LOCATION(S): LONDON, UK

PERSONS COVERED BY THE RISK ASSESSMENT: Chuyao Wang

BRIEF DESCRIPTION OF FIELDWORK (including geographic location): London city

COVID-19 RELATED GENERIC RISK ASSESSMENT STATEMENT:

Coronavirus disease (COVID-19) is an infectious disease caused by coronavirus SARS-CoV-2. The virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Droplets fall on people in the vicinity and can be directly inhaled or picked up on the hands and transferred when someone touches their face. This risk assessment documents key risks associated fieldwork during a pandemic, but it is not exhaustive and will not be able to cover all known risks, globally. This assessment outlines principles adopted by UCL at an institutional level and it is necessarily general. Please use the open text box 'Other' to indicate any contingent risk factors and control measures you might encounter during the course of your dissertation research and writing.

Please refer to the Dissertation in Planning Guidance Document (available on Moodle) to help you complete this form.

Hazard 1: Risk of Covid -19 infection during research related travel and research related interactions with others (when face-to-face is possible and/or unavoidable)

Risk Level - Medium /Moderate

Existing Advisable Control Measures: Do not travel if you are unwell, particularly if you have COVID-19 symptoms. Self-isolate in line with NHS (or country-specific) guidance.

Avoid travelling and face-to-face interactions; if you need to travel and meet with others:

- If possible, avoid using public transport and cycle or walk instead.
- If you need to use public transport travel in off-peak times and follow transport provider's and governmental guidelines.
- Maintain (2 metre) social distancing where possible and where 2 metre social distancing is not achievable, wear face covering.
- Wear face covering at all times in enclosed or indoor spaces.
- Use hand sanitiser prior to and after journey.
- Avoid consuming food or drinks, if possible, during journey.
- Avoid, if possible, interchanges when travelling - choose direct route.
- Face away from other persons. If you have to face a person ensure that the duration is as short as possible.
- Do not share any items i.e. stationary, tablets, laptops etc. If items need to be shared use disinfectant wipes to disinfect items prior to and after sharing.
- If meeting in a group for research purposes ensure you are following current country specific guidance on face-to-face meetings (i.e rule of 6 etc.)
- If and when possible meet outside and when not possible meet in venues with good ventilation (e.g. open a window)
- If you feel unwell during or after a meeting with others, inform others you have interacted with, self-isolate and get tested for Covid-19

- Avoid high noise areas as this mean the need to shout which increases risk of aerosol transmission of the virus.
- Follow one way circulation systems, if in place. Make sure to check before you visit a building.
- Always read and follow the visitors policy for the organisation you will be visiting.
- Flush toilets with toilet lid closed.
-'Other' Control Measures you will take (specify):

NOTE: The hazards and existing control measures above pertain to Covid-19 infection risks only. More generalised health and safety risk may exist due to remote field work activities and these are outlined in your Dissertation in Planning Guidance document. Please consider these as possible 'risk' factors in completing the remainder of this standard form. For more information also see: Guidance Framework for Fieldwork in Taught and MRes Programmes, 2021-22

Consider, in turn, each hazard (white on black). If **NO** hazard exists select **NO** and move to next hazard section. If a hazard does exist select **YES** and assess the risks that could arise from that hazard in the risk assessment box.
Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.

ENVIRONMENT	**The environment always represents a safety hazard. Use space below to identify and assess any risks associated with this hazard**
e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.	Low risk

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	work abroad incorporates Foreign Office advice
	only accredited centres are used for rural field work
	participants will wear appropriate clothing and footwear for the specified environment
	refuge is available
	work in outside organisations is subject to their having satisfactory H&S procedures in place
√	OTHER CONTROL MEASURES: please specify any other control measures you have implemented: Participants, interviewers and interviewees all wear masks throughout the survey and interview. Do the survey and interview online.

EMERGENCIES	**Where emergencies may arise use space below to identify and assess any risks**
e.g. fire, accidents	There is a risk of COVID-19 infection, which may also lead to serious illness or other complications.

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	participants have registered with LOCATE at http://www.fco.gov.uk/en/travel-and-living-abroad/
√	contact numbers for emergency services are known to all participants
√	participants have means of contacting emergency services
	a plan for rescue has been formulated, all parties understand the procedure

	the plan for rescue /emergency has a reciprocal element
√	OTHER CONTROL MEASURES: please specify any other control measures you have implemented: Try to conduct interviews online.

EQUIPMENT	**Is equipment used?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. clothing, outboard motors.			

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	the departmental written Arrangement for equipment is followed
	participants have been provided with any necessary equipment appropriate for the work
	all equipment has been inspected, before issue, by a competent person
	all users have been advised of correct use
	special equipment is only issued to persons trained in its use by a competent person
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

LONE WORKING	**Is lone working a possibility?**	**YES**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. alone or in isolation lone interviews.	Low risk It might be difficult to summon help. Interviewing alone run the low risk of encountering personal attacks and racial discrimination.		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	the departmental written Arrangement for lone/out of hours working for field work is followed
	lone or isolated working is not allowed
√	location, route and expected time of return of lone workers is logged daily before work commences
√	all workers have the means of raising an alarm in the event of an emergency, e.g. phone, flare, whistle
√	all workers are fully familiar with emergency procedures
√	OTHER CONTROL MEASURES: please specify any other control measures you have implemented: Try to conduct interviews online.

ILL HEALTH	The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.
e.g. accident, illness, personal attack, special personal considerations or vulnerabilities.	Low risk There is a risk of COVID-19 infection, which may also lead to serious illness or other complications. A low risk of personal attack and racial discrimination is possible for participants and interviewers on the way to interview.

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
√	all participants have had the necessary inoculations/ carry appropriate prophylactics
	participants have been advised of the physical demands of the research and are deemed to be physically suited
	participants have been adequate advice on harmful plants, animals and substances they may encounter
√	participants who require medication should carry sufficient medication for their needs
√	OTHER CONTROL MEASURES: please specify any other control measures you have implemented: Try to do survey and interviews online. If the interview is face-to-face, choose a safe location during daytime working hours.

TRANSPORT	Will transport be required	NO	√	Move to next hazard
		YES		Use space below to identify and assess any risks
e.g. hired vehicles				

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	only public transport will be used
	the vehicle will be hired from a reputable supplier
	transport must be properly maintained in compliance with relevant national regulations
	drivers comply with UCL Policy on Drivers http://www.ucl.ac.uk/hr/docs/college_drivers.php
	drivers have been trained and hold the appropriate licence
	there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods
	sufficient spare parts carried to meet foreseeable emergencies
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

DEALING WITH THE PUBLIC	Will people be dealing with public	YES	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. interviews, observing	Low risk Off-line interviews run the low risk of encountering personal attacks and racial discrimination. There is a low risk of offending and being misunderstood by interviewees during the interview.		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
√	all participants are trained in interviewing techniques
	advice and support from local groups has been sought
√	participants do not wear clothes that might cause offence or attract unwanted attention
√	interviews are conducted at neutral locations or where neither party could be at risk
√	OTHER CONTROL MEASURES: please specify any other control measures you have implemented: Try to do survey and interviews online. If the interview is face-to-face, choose a safe location during daytime working hours.

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WORKING ON OR NEAR WATER	Will people work on or near water?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. rivers, marshland, sea.	Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	lone working on or near water will not be allowed
	coastguard information is understood; all work takes place outside those times when tides could prove a threat
	all participants are competent swimmers
	participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
	boat is operated by a competent person
	all boats are equipped with an alternative means of propulsion e.g. oars
	participants have received any appropriate inoculations
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)	Do MH activities take place?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.	Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	the departmental written Arrangement for MH is followed

- [ ] the supervisor has attended a MH risk assessment course
- [ ] all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities
- [ ] all persons performing MH tasks are adequately trained
- [ ] equipment components will be assembled on site
- [ ] any MH task outside the competence of staff will be done by contractors
- [ ] OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

SUBSTANCES	Will participants work with substances	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**		

	the departmental written Arrangements for dealing with hazardous substances and waste are followed
	all participants are given information, training and protective equipment for hazardous substances they may encounter
	participants who have allergies have advised the leader of this and carry sufficient medication for their needs
	waste is disposed of in a responsible manner
	suitable containers are provided for hazardous waste
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

OTHER HAZARDS	Have you identified any other hazards?	NO	If 'No' move to next section If 'Yes' use space below to identify and assess any risks
i.e. any other hazards must be noted and assessed here.	Hazard: Risk: is the risk		
CONTROL MEASURES	**Give details of control measures in place to control the identified risks**		

Have you identified any risks that are not adequately controlled?		
NO	**NO**	**Move to Declaration**
YES		**Use space below to identify the risk and what action was taken**

DECLARATION	The work will be reassessed whenever there is a significant change and at least annually. Those participating in the work have read the assessment.

Select the appropriate statement:

x	I the undersigned have assessed the activity and associated risks and declare that there is no significant residual risk
	I the undersigned have assessed the activity and associated risks and declare that the risk will be controlled by the method(s) listed above

NAME OF SUPERVISOR Lauren ANDRES

BPLN0039_QPFW1

GRADEMARK REPORT

FINAL GRADE

/100

GENERAL COMMENTS

Instructor

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