Addressing Car Dependency in Galway, Ireland:
A Time for Change?

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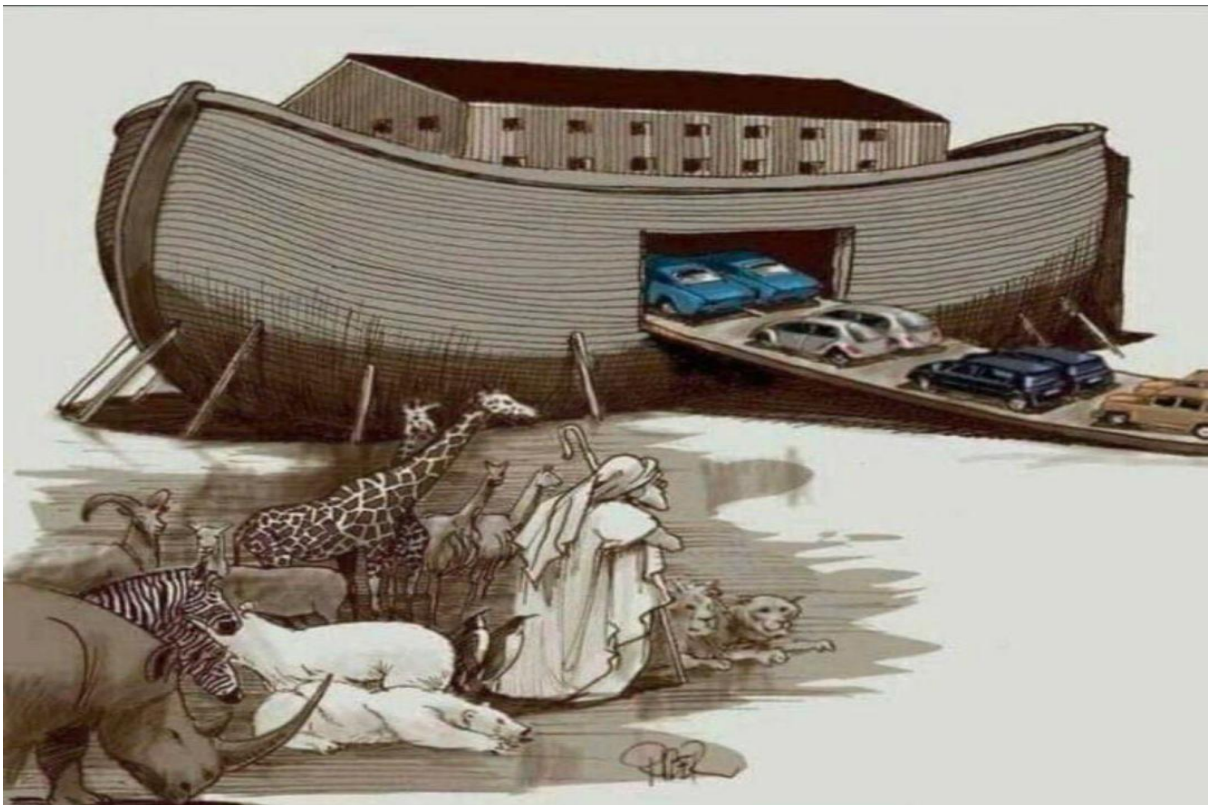
(Hansson, 2022)

Abstract

This research focuses on the concept of car dependency in the city of Galway, Ireland. Society's view on car use is currently in transition as more and more people grow to understand the effects it has on the climate as well as social and economic issues such as congestion and damage to the public realm.
Galway is a relatively small city which has been found to rely heavily on private cars for transportation. While other cities in Ireland and Europe have made drastic changes in order to create a more sustainable transport model, Galway is struggling to move away from its car centric infrastructure. This reluctance, as well as the city's small scale, makes Galway an interesting case study for this topic.

The research aimed to gain an understanding of which factors influence car use/dependency in Galway. Specifically it looked at how utility issues such as car parking availability, barriers to alternatives and journey distances influence car dependency while simultaneously looking at and comparing the effects environmental awareness has on car dependence.

This was achieved with quantitative and qualitative research. An online survey gathered the opinions and transport habits of the general public (quantitative). Thereafter, multiple regression analyses were employed in order to measure direct and moderating effects of the utility issues and environmental awareness on car dependent behaviour. Key findings were then posed to the outgoing Mayor of Galway, in order to understand how they viewed the influence of each variable and moderator on car dependency. The interview also offered insight into how the political climate reacts to proposed change.

Regarding the utility issues, the research concluded that distance and availability of parking to be significant predictors of car dependency in Galway. Meanwhile an awareness of sustainability issues also influenced the predictability of car dependence. The qualitative findings mirrored these results with the interviewee calling for a reduction in car parking spaces, increased public and active transport and awareness of issues pertaining to car dependence but not limited to sustainability concerns.

This paper contributes to the knowledge pool surrounding car dependency and transport related sustainability issues in general but also specifically to the Irish context. The paper recommends a mixed methods approach to dealing with car dependence in Galway. Policy makers should inhibit car use by making driving less attractive (reducing car parking) while simultaneously promoting alternative modes and educating the public about the negative effects of choosing private cars as their main mode of transport. This might be achieved by reducing parking at central locations and places of work/education, building more densely with planned sustainable transport in mind and encouraging the public to rethink their transport habits in favour of the environment.

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Chapter 1

Introduction

This chapter introduces the place of private motor cars across society and how its role might evolve in the future due to environmental and social problems associated with them. The aim of this research is then presented, followed by the research questions. The case study and relevancy of Galway, Ireland will be presented thereafter. Finally, a short reading guide is provided.

1.1 - Background

The private motor car is a modern phenomenon that has taken the entire world by storm, becoming a symbol for global progression and technological advancement in the process (Siegelbaum, 2011). Post World War II, cars promised modern society a brand new lease of freedom as well as opportunity by further adopting globalisation into our economic activities (Sheller and Urry, 2000). While the car is frequently hailed as a wondrous and necessary tool for the fast paced modern lifestyle, its reputation has begun to take a turn for the worse (Mo.Ve. Association, 2008, p. 3).

 The city has evolved with the capabilities of the car, adding amenities such as drive thru's for all sorts of products from food to pharmacy medication (Padilla and Faller, 2022), along with the addition of multi-story car parks and extensive motorway networks. The urban, in many respects, serves the car (Gonzales, 2015). However, in more recent times, people have begun to question the place of cars in our daily lives and how we should adapt our cities to serve all of its people (Huffine, 2013).

The societal rethink of the car's place in our cities can largely be attributed to the ensuing climate emergency the world is experiencing (Wee, 2014, Saunders, 2008). Transport related emissions make up 16.2% of the world's total emissions output (Ritchie et al., 2020). In Ireland this figure reaches 17.7%, with cars making up ~13% of the overall figure (EPA, 2021, Ginty, 2019). While electric and hydrogen powered vehicles are grabbing the headlines for the optimal transition tool away from the current carbon intensive transport model, a plethora of scientists, politicians and

members of the general public are making the argument of a reduced reliance on car related transport as a whole as a means of solving economic and social issues as well as climate related ones (Dey et al., 2019, Dallman et al., 2019, Yassin, 2019).

Numerous groups are now calling for an increase in car-free or reduced car areas in towns and cities across the world (Limb, 2022, Jones, 2022). These campaigns are being fought by advocating for changes in the built environment, streetscape and alternative infrastructure provision as well as spreading awareness regarding the impacts cars can have on commercial activity, public realm and air quality, amongst many others. This research takes both of these aims into account. By testing the impacts of these influencing factors on a case study location, the research hopes to identify the primary driver of creating a car dependent society in a city like Galway.

Litman (2014) illustrated multiple influencing factors of car dependency, three of which are more closely examined in this study: car parking, the built environment and availability of alternative transport options. These specific topics were chosen due to the significant overlap that is seen in research (as illustrated below) (Guo, 2013, Belzer and Autler, 2002, Tyrinopoulos and Antoniou, 2013).

In other research, car dependency has been defined by factors such as age, choice of residence and income (Saeidizand et al., 2022). However, the author opted to focus on the elements examined by Litman (2014) and López-Mosquera et al. (2015) as he believed that car dependence existed across each of these demographics in Galway. López-Mosquera et al. (2015) found that those who are more environmentally aware are more likely to reduce their car use. However, other literature claims increased environmental awareness had no effect on one's car use (Sottile et al., 2015, Csutora, 2012).

This research aims to provide a unique perspective on car dependence, offering a comparative study of the effects that ease of use and sustainable attitudes have on people's car usage.

Firstly, car parking has been found to be a key enabler of car mobility and dependency (Yin et al., 2018, Litman, 2014). Guo (2013) found that being certain of

car parking availability at one's home increased the likelihood of one using their car. Uncertainty would decrease the likelihood of them choosing their car. Cost of parking was found to also have an impact on one's modal choice (Shiftan and Golani, 2005, Kelly and Clinch, 2009).

Secondly, cities with low population densities such as New Orleans (2265.6 people per square mile) are prone to becoming car dependent (US Census Bureau, 2020, Manville et al., 2013, Su, 2011). This is due to several reasons including the streetscape being intentionally designed for car traffic (Belzer and Autler, 2002). Low population density areas are less likely to be able to build effective public transport networks as focal points for connections are difficult to establish with a dispersed population (Patacchini et al., 2009). Such sprawling cities also result in much of its population living far away from town centres, shopping areas and other amenities (Manville et al., 2013). This makes it more difficult for people to make use of active transport modes like walking and cycling (Seliske et al., 2012, Tiemann et al., 2008).

In order to coax people away from their cars, alternative viable options must be provided (Pritchard, 2022). This means that alternative options satisfy concerns such as reliability, safety, financial costs and effectiveness/speed (Masoumi, 2019, Pritchard, 2022). Regarding public transport, reliability of service generally tops the list of people's concerns about relying on the service (Tyrinopoulos and Antoniou, 2013). While active transport becomes less attractive with a lack of safety/infrastructure and distance (Kotahi, 2021).

Irish people are now very aware of and concerned by the effects of climate change (Timmons et al., 2022, Leiserowitz et al., 2021). This awareness has translated to the majority of Irish people making changes to their lifestyles in support of efforts to suppress climate catastrophes (Leiserowitz et al., 2021). Research has found that 51% of Irish people would like to make the switch to an electric car (Carzone, 2022). However, this cannot be attributed solely to people's concerns for the planet. The numerous financial benefits and subsidies being offered by the government as well as the increase in the cost of fuel are seen as key motivators behind this push (McBrien, 2018, Carzone, 2022).

Cars are, by far, the most popular mode of transport in Ireland. Car journeys make up almost 73.7% of journeys taken in the Republic (CSO, 2019). Their popularity is longstanding after car ownership exploded towards the latter half of the 20th century. The average number of licensed vehicles on Irish roads between 1985 and 1989 was equal to 960,000. This would increase by 183% to 2.7 million vehicles by 2018. Private cars accounted for the majority of these vehicles. The national private car fleet skyrocketed by 1.4 million vehicles in this period (CSO, 2019). This surpassed the human population growth rate. Ireland's population grew by just 1.32 million people during the same period (CSO, 2018). Simultaneous to this rapid popularity in cars, public transport witnessed a noticeable decline in ridership. For instance, public bus and coach patronage declined from an average of 234.1 million customers in 2005-2009 to an average annual low point of 194.9 million riders in 2010-2014 (CSO, 2019). Bus usage began to climb again from this point. 226 million people rode the bus in 2019 (CSO, 2019). After an unprecedented slash in ridership in 2020, thanks to the COVID-19 pandemic, ridership is said to be slowly increasing to ridership levels seen in March 2020 (Duffy, 2022).

Car ownership is also continuing to grow, however. Since 2018 an average of 110,000 vehicles have been added to Irish roads. As of December of 2019, county Galway had 154,414 licensed vehicles in the county, 117,618 of which are private cars (CSO, 2019).

Galway City

The city of Galway is an historic mediaeval city which lies on the River Corrib and Galway Bay on Ireland's rugged west coast (Ren et al., 2015). Galway is relatively small in terms of both size and population. Roughly 85,000 people live within the 54.2km² city boundaries (CSO, 2022). While the county of Galway, in which Galway city is located, is home to 276,451 people (CSO, 2022). County Galway is the second largest county on the island of Ireland and Galway city is the 6th largest city on the island, 4th largest in the Republic (Gardham, 2022).

The town of Galway was founded by Norman leader Richard de Burgh in the 13th century. It quickly gained the status of a port city, exporting commodities such as

animal hides and wool and importing wine. Much of its trade was with fellow coastal towns in Spain and France (Walsh, 1992). The town would develop over time, evolving from its port and defensive functions into a market town run by wealthy merchants (Lambert, 2016). Nowadays, Galway is a significant market town and tourist hub (Morrison, 2020). It is also a prominent location for biomedical device manufacturing and related services. For example, Boston Scientific and Medtronic are amongst the city's largest employers (O'Doherty, 2021, Taggart, 2022)

Galway is also a major university town. The city has multiple third level institutes, including 2 universities, NUI Galway and Atlantic Technical University (Bowers, 2022). Students living in Galway make up over 20% of the city's population (NUIG, 2022). As a result, Galway is a very youthful city where the average age is 35.9 (CSO, 2016).

In terms of transportation planning, Galway began paving its roads in 1505 when horse and cart was the preferred modal choice (Lambert, 2016). In 1879, an entrepreneur named Mr. Berry created a horse driven tram from the centre of the town towards the coastal village of Salthill. The effects of World War I terminated this route as the British army commandeered all of the company's horses. Bus services began in 1919 and ran under private ownership until 1945 when the CIE took it over when they began operating both rail and bus across the country (Galway Advertiser, 2016).

Galway now has a moderately extensive road network throughout the city. The city's mediaeval past means many of its streets are narrow. Anecdotally, this does not lend well to the creation of wide footpaths or bike/bus specific lanes. A maximum speed limit of 50 km/h is in place inside the city bounds. However, this is due to be reduced to 30 km/h despite staunch opposition in Galway City Council (Farragher, 2022) (see image 3.4.3).

Galway now has multiple bus routes navigating the city and county as well as a train station that offers local and national routes. The National Transport Authority (NTA) has announced substantial plans to improve both networks. The NTA is in the process of launching *Bus Connects*, a plan which is described as a "*game changer*" for public transport across each of Ireland's cities (Ní Aodha, 2022). Regarding rail,

Galway currently only has a single rail line from Athenry into the city's Ceannt Station. The NTA plans to double track this route by 2025, increasing route capacity for the city and its environs to the east (McGrath, 2022).

Active transport in Galway has not achieved the same levels of progress as public transport. This is despite national government policy strongly supporting the creation of walking and biking infrastructure across the state. The Department of Transport made €289 million available for such projects (Gov.ie, 2022). Recently it has been uncovered that only 56% of this capital has been used by local councils in rural areas to develop their active transport infrastructure. Councils in the Greater Dublin Area (GDA) and regional cities, like Galway, left 37% (€88 million) of their allocation unspent (Meskill, 2022). Galway, specifically, left 52% (€6,293,487) of their allocation unspent (NTA, 2022).

 Most noticeably, Galway City Council made a U-turn on their decision to create a 2-way segregated cycleway along the Salthill coastline. Councillors opposed its construction on the basis of the resulting reduction of parking and potential disturbance for emergency services access (Farragher, 2022). In relation to walking infrastructure, the council launched a multi-million euro scheme to redevelop the city centre, further pedestrianising the city. While certain streets have been closed off to car traffic, no surface works have taken place there. The city's main thoroughfare, Shop Street, has been resurfaced. The traditional cobblestones have been replaced by black tarmacadam (Cassidy, 2019).

Image 1: Shop Street prior to redevelopment (GalwayAdvertiser.ie)

Image 2: Shop street following redevelopment (ConnachtTribune.ie)

The city ring road remains as a prime focus of developing Galway's transport infrastructure. The €600 million investment hopes to curtail congestion in the city by providing a 4 lane, 18km route looping around Galway's urban area (Murray, 2021, Dwyer, 2021). Controversy has continued around this plan as politicians and the general public argue over the effect the road will have on congestion, commerce and the climate (Dwyer, 2021). Furthermore, Galway makes the headlines in the national media for its problems with traffic and transport in general (McGee, 2022, Beasley, 2022, McGrath, 2021, Larkin, 2017).

1.2 - Research aim

This paper applied previously researched theories to a case study in order to decipher whether car dependent behaviour can be primarily attributed to car use/practicality issues, such as built environment, car parking and alternative transport options, or the existence of an ingrained car culture which trumps other factors when it comes to choosing one's mode of transport. Each of these minor elements have been tested and are widely acknowledged to determine car dependence (Guo, 2013, Belzer and Autler, 2002, Tyrinopoulos and Antoniou, 2013). However, there remains a shortcoming in the literature which pits these "ease of use" effects against the effects of personal attitudes, such as being environmentally conscious, on car dependence. This research therefore hopes to explore this gap.

As has been explained in the proceeding section, Galway, despite its small scale, is subject to a high level of car dependency (Hynes, 2017). Galway is an interesting city to base this research on as while other Irish and European cities have recently adapted significantly more sustainable transport models, Galway has not experienced this paradigm shift (English, 2022, Nevin, 2022). This begs the question why Galway is almost unique amongst similar developed European cities in committing to the widely criticised status quo (McGee, 2022, Rossi, 2022). In an attempt to summarise the current state of affairs in Galway, a national newspaper recently ran a story about the city's transport model, entitled: "*Galway: Where the car is still king and 'glaciers move faster than the council'* "(McGee, 2022). This prompts the question as to why Galway continues to evade change.

While there is a clear argument that Galway is less committed to reducing car use in comparison to other like cities (McGee, 2022), the reason as to why is much less straightforward. This research therefore aims to apply the aforementioned theories in both the quantitative and qualitative analysis, in order to understand to what extent Galway's car use habits can be attributed to practical/infrastructural issues as well as to personal attitudes, specifically environmental consciousness. This research will therefore offer an interesting insight into where cities should focus their efforts when aiming to transform their transportation network.

1.3 - Research questions

This research aims to give a broad and wide ranging understanding of the existing transport network in Galway city as well as the attitudes of its citizens towards it. Through a mixed methods approach, the paper hopes to gain knowledge about the spurring influences of car dependence in Galway. As a means to gain intelligence regarding this issue, the following research question was developed:

"To what extent do car utility issues and environmental awareness influence car dependency in Galway, Ireland?"

In order to formulate a valid response to this question, the following sub questions were also developed.

1. How do Galwegians travel to the city centre and their places of work/education?
2. How does one's address affect the likelihood of choosing to travel by car in Galway?
3. How does the provision of parking affect one's choice to drive in Galway?
4. To what extent does one's attitude towards/awareness of car use and environmental problems affect their decision to drive?
5. Are people living in Galway dependent on their car due to a lack of alternatives via public transport and active transport (walking and cycling)?
6. How do policy makers view the issue of car dependency and what do they see as the main difficulties in tackling it?

By answering these questions, a clearer understanding of the crux of Galway's transport issues will be identified and thereafter, with a qualitative analysis, it will be possible to ask a relevant policy maker how they believe these issues and concerns can be resolved.

1.4 - Case description and relevance

The city of Galway, located on Ireland's west coast, is the country's fourth largest city and hosts a city population of roughly 85,000 (CSO, 2016). The city is famed for its deep rooted Irish culture, language and its abundance of festivals (Moore, 2020). While most flock to Galway for its bustling centre, scenic nature, friendly locals and abundant calendar of various festivals (Ó'Conghaile, 2020), the city has now become infamous for its congestion and lack of alternative transport options (Fahy and Cinnéide, 2008).

Much like in other Irish cities, Galway is a very car dependent city. Recent studies show that around 58% of Galwegians travel to their place of work or study by either private car or van. Meanwhile 29% utilise active travel (walking or biking), 9% used bus services and less than 1% commuted by train (Hynes, 2017).

Galway city council appear to be taking a softer approach to tackling car use than their Dublin city counterparts. In 2021, the council voted almost unanimously (17 votes to 1) in favour of creating a 2 way segregated cycleway along the Salthill promenade in order to promote cycling in the area. The decision was later reversed, however, in favour of maintaining the status quo, mostly due to the concerns of lost parking and access for emergency services (Farragher, 2022). The latter has been argued to be an unfounded concern by advocates who cite a similar Dublin based cycleway as being unproblematic and even advantageous for "blue light" service access (Ginty, 2022). Almost perfectly parallel on the timeline to these decisions, a 4 lane city ring road was approved with the aim of tackling congestion in the city centre. The latter decision provoked criticism amongst active transport lobbyists as well as the Irish planning authority, An Bord Pleanála (ABP). In their granting of permission for the project, ABP accepted that the ring road would not be successful in curtailing car use and or congestion (An Bord Pleanála, 2021).

The black hole of highway investment

Public pressure
to add capacity

Highway
congestion

Capacity added

Further
congestion

Car travel
gets easier

More car trips
more often

More attractive
to liv/work/shop
further away

Average trip length
increases
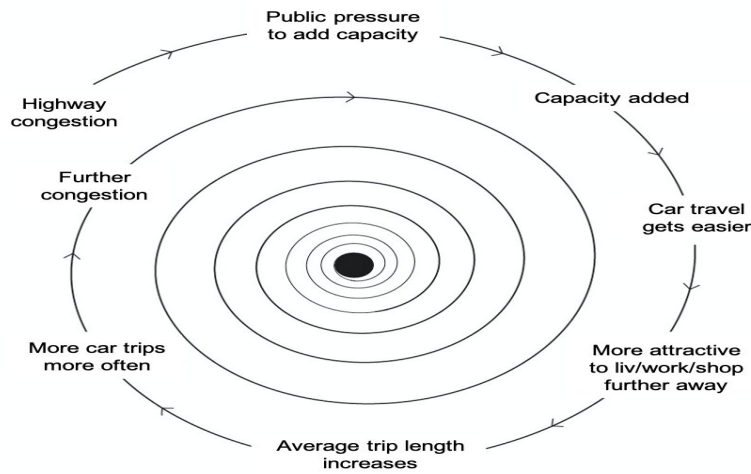
Bron: D.A. Plane, 'Urban transportation: policy alternatives'. In: Hanson & Giuliano (red.), The Geography of Urban Transportation (tweede editie), Guilford Press (1995), p. 439.

Figure 1: The blackhole of highway investment (Hanson and Giuliano, 1995)

Supplementary to this, Galway city, while small in size, proportionally offers more parking than any other Irish city (Rogers et al., 2013), with a decent amount being offered free of charge by the council (Galway City Council, 2022). As will be discussed in further detail, multiple studies have found that the provision of ample and free car parking in and near the city centre is a direct incentive for citizens to opt for private car travel over public or active transport options and therefore spurs on the use of cars (Sprei et al., 2020, Chevallier et al., 2018).

1.5 - Reading Guide

This thesis is explored through 5 chapters. The next chapter consists of a theoretical framework/literature review which looks at the various theories surrounding car dependency. Theories most relevant to Galway were the focus of this section. Chapter 3 documents the types of methodologies employed by this research. The chapter explains how the data was collected for both the qualitative and quantitative analyses. Subsequently, chapter 4 lays out the key findings of the survey (quantitative) as well as the expert interview (qualitative). Finally, in the last section

a discussion and conclusion of the research is compiled along with limitations of the research process and recommendations for any future studies relating to the topic.

Chapter 2

Theoretical Framework

This chapter aims to define car dependency and thereafter presents a short history of the role of the automobile across different cultures and socio-economic demographics. The focus then shifts towards an Irish and then Galway context. Different theoretical analyses are then examined to understand the factors that foster and enable a car dependent culture and why this may be negative for a society such as Galway, Ireland.

2.1 - Car Dependency

Car dependency can be viewed from the individual/user perspective, as well as from the policy-maker/city perspective. In defining CD, Newman and Kenworthy (1999) focus on the latter. They defined it as when private car use becomes the dominant mode of transport in a city or area and as a result all decisions regarding infrastructure, zoning and transportation become heavily influenced by its dominance. Meanwhile other literature relate it more to the choice of an individual where it is defined as a situation where residents of a certain area/city have no other alternative transport method aside from a private car (Wiersma et al., 2017) (Jeekel, 2013). While the decision to drive ultimately comes down to the choice of the individual, the contributing factors in forming this decision are directly influenced by policy. This point will be further developed later in this literature review. For the purpose of this study, the definition of CD will not be limited to where no alternative mobility options are available. Instead the focus of the definition will be on societal dependence, where a car culture is dominant and therefore ingrained in society. Car dependency is arguably the most common term for such a situation. However, other scholars have referred to it as automobile dependency (Litman, 2002).

Researchers point to CD as being a barrier to progress towards a sustainable transport model (Curtis and Low, 2016, Litman and Burwell, 2006). This is due to policymakers and those who are reliant on cars being unaccepting of change as well as the car being such a core part and norm in society (Mattioli, 2016). This is all

despite the "*increasing awareness of the negative externalities* [of car dependency]" (Mo.Ve. Association, 2008, p. 3). Multiple studies show that continuing on this pathway will make us more vulnerable to adverse changes in social, economic, environmental issues (Wiersma et al., 2017, Dennis and Urry, 2009).

2.2 - The Rise of the Automobile

Throughout history, cities have grown and evolved around the needs of humans on foot, horseback, boat and later, cycling. This resulted in dense and social city centres, often with narrow roads (Wallstrom, 2020). With the dawn of the automobile, the streetscapes of cities began to be reinvented to provide sufficient road space and parking to accommodate car traffic.

As cars continued to grow in popularity, cities continued to grow in size. Most notable examples being Los Angeles and Houston in the U.S.. These cities experienced dramatic urban sprawl as citizens sacrificed long commuting distances for cheaper and more spacious properties away from the hustle and bustle of city life but at the same time have it within easy reach for employment, services and entertainment amongst other things (Kenworthy and Laube, 1999). The expansion of cities therefore led to more car use and demand for car infrastructure such as wider roads, motorways and parking (Belzer and Autler, 2002).

The first commercial motor cars started to become mainstream in Ireland from the 1950's and ever since then, the widespread use of cars has become completely entwined into human culture not only in Ireland but all around the world (Kenco, 2016). Ireland now has in excess of 2 million private cars on her roads, a considerable figure given the nation's small population of roughly 5 million people (MacAleer, 2020). Ireland is deemed to be a strongly car dependent country. Multiple studies have classified Ireland as being amongst the most car dependent in Europe (Commins and Nolan, 2010; Rau and Vega, 2012, Hynes 2014).

2.2.1 - A Global Issue

Ireland is not unique in its over reliance on the automobile. Most western countries also experience this dependency, so much so that it is now widely considered a "spiralling" problem due to the spatial and environmental impacts which are incredibly difficult and expensive to reverse (Paterson, 2000, Lewis & Grande del Valle, 2019). The problem is arguably most evident in the United States where people make over 85% of their daily trips by car. This is in stark contrast with socio-economically similar countries in Europe where 50-60% of people's daily trips are made by car. Notably, in the United Kingdom, 75% of the distance travelled by the average inhabitant is made by car (Jones, 2011). Americans, however, are drastically more car dependent than their European counterparts when it comes to short distance travel. For daily trips of less than 1.7km/1 mile, 70% of Americans used a car while only 30% of Europeans did the same.

The dominance of car culture is not limited to the global north, or even the western powers. The global south has followed the same pathway as the global north and as a result, the majority of urban dwellers in the global south rely on motorised road transportation (cars and buses) as the option to walk or cycle is totally unfeasible (Pojani and Stead, 2018). While the use of buses aids in reducing car dependence, the reliance on motorised transportation negates a cities opportunities to benefit from using active transportation. Benefits include improvements for the environment, public health and public realm (Rabl and De Nazelle, 2012).

The increasing trend of car dependency is not universal, however. Many global cities such as Tokyo, Brussels and Geneva have achieved significant reductions in their car fleets in recent times (Saeidizand et al., 2022). These, along with the more obvious examples of Copenhagen and Amsterdam, showcase the feasibility of driving a modal shift away from private motor transportation as well as the benefits that can be derived from such a shift (Koglin et al., 2021, Nieuwenhuijsen and Khreis, 2016, Rabl and De Nazelle, 2012).

2.2.2 - The Irish Experience

While this thesis will focus on the city of Galway in particular, the national context remains relevant given the nature of the State's centralised government and how policy is in turn developed and implemented in the relevant jurisdictions.

As previously stated, Ireland is no different when it comes to its relationship with private car transportation. Ireland has a car ownership rate of 436 per 1,000 of its population. While this is actually on the lower side of the spectrum in comparison to fellow European Union members (19th of 28*) (CSO, 2016), it begs the question why Irish cities are continuously designed to facilitate car traffic, reinforcing a car culture (Holland, 2013) (Litman, 2002).

Car journeys are often the fastest, cheapest and most convenient method of travel for Irish people. This helps to explain why 57% of trips in Ireland under 2km are made by car (CSO, 2016) as well as why 37% of fuel for passenger transport is used for journeys under 8km (O'Riordan et al., 2022). In order to address this issue, Dublin City Council C.E.O, Owen Keegan, has recently announced that his team will aim to "*aggressively restrict*" car use in his jurisdiction (Kelly, 2022). This proposal has received hostile protests from politicians and constituents alike as they argue he has no mandate to take such actions, due to the previously mentioned centralised nature of the Irish government as well as the fact that city C.E.O.'s are not elected by the people (McDowell, 2022).

The trend of car dependency only grows outside the capital. In the most recent data available, the Central Statistics Office found that in all regions outside of the Greater Dublin Area (G.D.A.), 83% of journeys were made by private car. Furthermore, only 5.1% of trips were as a passenger, meaning that most cars on Irish roads serve only the driver of the car (CSO, 2016).

* Data gathered prior to Brexit. Includes the United Kingdom.

2.3 - Influencing factors of car dependency

The popularity of car use can be attributed to various objective and subjective factors. People hold multiple different attitudes towards car use. They can be subjectively dependent on their car based on their perception of car travel, their values, habits and attitudes (Wiersma et al., 2017). Alternatively, objective CD is whereby the context of a city, either through its physical and/or financial structures, disincentives the use of alternative modes of transport while facilitating cars (Wiersma et al., 2017). It is important to note that the aforementioned subjective factors are influenced by the objective factors implemented by a city. Government policy and planning practices have a direct effect on how its citizens will view transportation modes which affects their transportation choice. It is the role of local and national government as well as planners to shape the city towards incentivising more sustainable transport modes. This paper will focus on the objective factors and how they might be able to drive a shift in subjective attitudes.

Car dependency is a self reinforcing process. Both types of reasoning, subjective and objective, for relying on a car for transportation only further encourages other "cogs" of the cycle to become more inherent and pronounced (Litman, 2014) (see figure 1). For this reason, if cities seek to reduce car dependency, their policies should offer incentives to choose alternative modes. Examples include: better alternative mode infrastructure, services and financial measures. But also disincentivizing driving must also be addressed. Such measures might include reduced speed limits, congestion charges, elongated routes for cars and reduction in the availability of on street parking (Petrunoff et al., 2015). This section will explore some of the key influencing factors of how car dependency becomes a self reinforcing phenomenon in a society as set out by Litman (2014) (see figure 2).
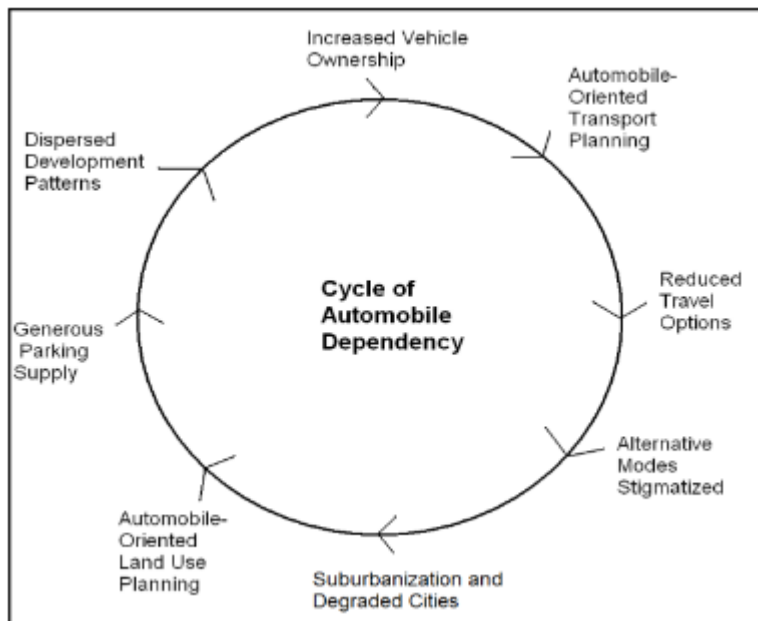
Figure 2: Cycle of automobile dependency (Litman, 2014)

2.3.1 - Built Environment and Sprawl

The form and layout of a neighbourhood will impact one's decision to drive over more sustainable alternatives. In a Chinese study it was found that areas people will drive more for non-work purposes when there are less intersections in the neighbourhood (Hong and Chen, 2014). Galway being a medieval city therefore lends well to reducing CD.

A city layout is given its true meaning and function by how transport services and infrastructure are implemented throughout (Lee et al., 2014). For example, a cyclable or walkable city will only be realised with the appropriate infrastructure. While public transport routes must align with the needs and realities of an area in order to become effective. It is common, however, that transport routes do not align with the desires of residents, meaning they must take indirect journeys that may not drop them from door to door. Li and Zhao (2017) found that distance and accessibility to metro stations in Beijing had a significant effect on whether residents would choose to travel by car or by public transport. Direct journeys have also been found to be highly influential in encouraging public transport use (Wu and Hong, 2016).

The Canadian urbanist, Brent Toderian, frequently prompts planners to design for the transport they want to have in their city (Toderian, 2007, Ruske, 2014). This means facilitating the modes we would like to encourage. Regarding public transport, that requires cities to ensure routes and stops are proximite, accessible, time effective, affordable and safe. Active travel, on the other hand, relies heavily on infrastructure as well as the planning of the city. For example, the "*15 minute city*" concept is heralded as a solution for planning towards active travel (Moreno et al., 2021). Simultaneously, the structure of the built environment can be altered to deter car use. One of the finest examples of this was measures taken by the municipality of Groningen in the 1970's. In order to make car use less attractive, policy makers segmented the city centre into 4 parts. One could not use a car to travel from one segment to the next without exiting their segment of origin and travelling around the city ring road, hence making driving less desirable in comparison to walking or cycling. Groningen is now one of the most cyclable and walkable cities on the planet (Hellemeir and Soltaniehha, 2010).

2.3.2 - Parking

There have been many studies conducted that have linked the availability of free and or ample parking as a leading incentive for people to choose to drive (Yin et al., 2018, Guo, 2013). One such study even concluded that parking availability and cost to be the primary factor affecting the modal choice of commuters (Tyrinopoulos and Antoniou, 2013).

Cars are parked for the majority of their lifetime. Some studies found that cars are parked for up to 80% - 95% of the day (Kitamura et al., 2001, Rogers et al., 2013, Shoup, 2018). This gives city planners and policy makers the very challenging task of storing these vehicles in central and sought after locations (e.g. commercial and residential areas) for the majority of the day until they are needed, typically, for rush hour traffic.

2.3.2.1 - Cost

Rogers et al. (2013) argue that each parking space generates traffic and as such by carefully managing parking, cities can curb undesirable congestion problems and car dependency. Wong et al. (2000) explored how Hong Kong fought CD while shifting towards higher public transport usage. One of the main methods used was introducing costly parking charges. The charges were so great that parking one's car often cost them more than the car itself (Rogers et al., 2013, Wong et al., 2000).

The concept of disincentivising parking through the introduction of financial measures is long established. For a long time global cities like New York and London did not charge for parking, however, their positions have altered dramatically in a relatively short space of time. Nowadays a New Yorker can expect to pay, on average (public and private parking), $570 per month for parking (SpotHero, 2022). This will be on top of the planned congestion charges of $12-$14 to be introduced in 2023 (Holliday Smith, 2021). Furthemore, New York has street cleaning days where residents are required to remove their vehicles from one side of the street, meaning countless car users must relocate their vehicles at once in a city that is already famished in terms of available space. This activity is deemed to be a disincentive to car use (Guo and Xu, 2013). Their study found a net increase of 7.1% miles travelled due to moving one's vehicle for these cleaning days.

The narrative around the introduction or increasing of parking charges is often controversial and cities must proceed with caution in how they frame these new policies to residents. It is important that residents understand it is a "car-curbing" measure rather than another tax for people to pay. For this reason, cities might create Parking Benefit Districts (PBD's). PBD's are areas that use revenue from parking to further improve alternative transport systems with the aim of reducing CD (Johansson et al., 2017). This is highly important as residents must not feel that they are being continuously remanded for using their only possible mode of transportation without the provision of alternatives. Barcelona, for example, invests parking revenue into its bike sharing scheme. (Rogers et al., 2013). The manner in which funds are collected and thereafter spent is also topical. Johansson et al. (2017) insist on a collaborative planning approach, as stipulated by Healey (1998), to ensure

effective policy and compliance. There have been calls in Ireland to replicate such measures after proving successful around Europe (Hoare, 2021).

2.3.2.2 - Availability

Ireland also has enduring problems with the provision of parking, both free and paid facilities. This is explored in the research of Rogers et al. (2013). The report found Galway to be the Irish city with the highest level of car use as well as being one of the jurisdictions with the lowest users of public transport (20 out of 30). This is especially surprising as Galway is one of only 5 cities in the Republic. The report then goes on to state that Galway has the second highest provision of parking in the country, second only to the mostly rural county of Monaghan. This statistic is described in relation to the availability of parking at multiple facilities, namely, residential, office, industrial and retail. The lowest score of one meaning the least amount of parking provided and the 30 being the highest provision of parking. Galway scored very highly for residential (29th) and industrial spaces (25th), mid-table for office spaces (11th), while amongst the lowest for retail (3rd). Overall, Galway's weighted score was the second highest in the country.

Interestingly, the low ranking of retail parking provisions does not have the same effects in reducing car dependency in central business districts (CBD's) as one might believe, given the prior argumentations and evidence. This can be explained by the research of Weinberger (2012). In her research, she demonstrates that one's CD can be attributed to the ample provision of parking at either side of their journey. So, in Galway's case we might assume that the residents may decide to use their car as it is easy for them to access their car going to a shop and, importantly, be confident that they can reclaim their space upon returning. Guo (2013) also acknowledged the realness of this phenomenon by studying neighbourhoods in New York. His research found that ample parking provision significantly affected the choice to own a car and also of its use.

2.3.3 - Car ownership

Cars are arguably one of the most revolutionary technologies produced by mankind. Their ease of use and independence they offer have transformed how people travel. This isn't without its pitfalls however, as the costs of running a car is a burdensome liability for an average Irish person. The average annual running cost of a family car in Ireland is now estimated to be above €10,000 (McBride, 2021). It is important to note that this figure was calculated prior to the oil price increases as a result of the Russian invasion of Ukraine and the ensuing cost of living crisis affecting much of the planet. As such we can expect the current figure to be even higher. Much of this figure is seen to be a "sunk cost", in the form of insurance, car payments and tax. This means that much of a car's costs are incurred regardless of frequency of use. So by relying on cars for longer journeys, people will have already endured this sunk cost and therefore are more likely to also opt to travel by car for all journeys (Litman, 2020).
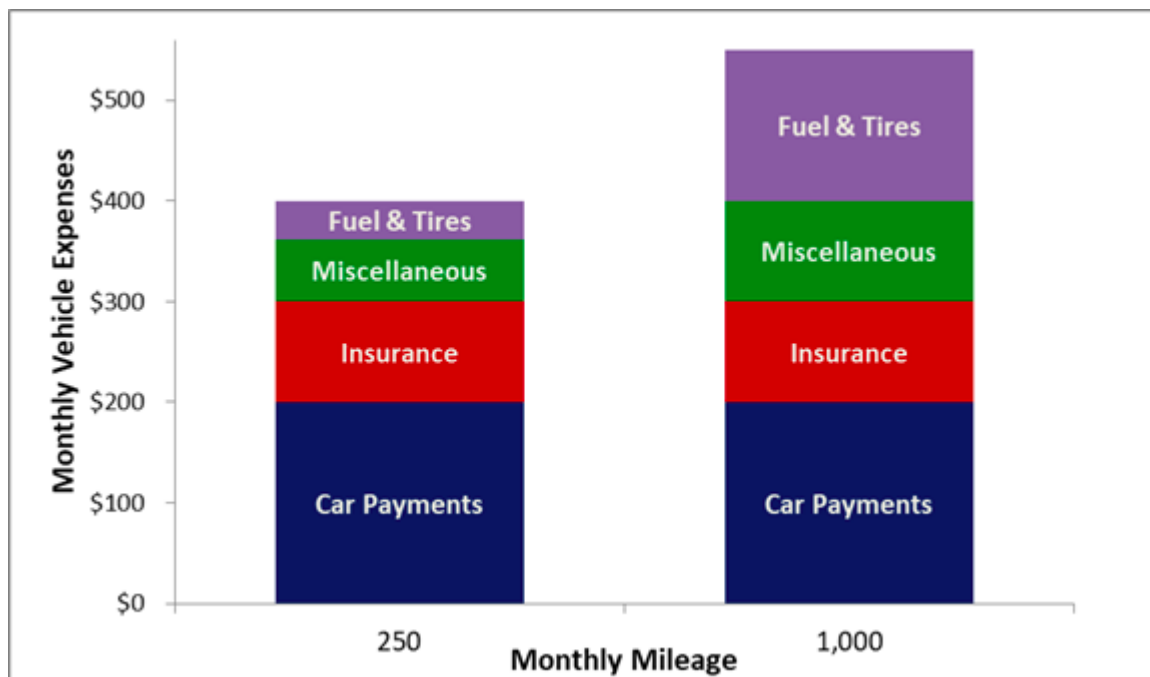
Figure 3: Graph showing American car costs. The graph depicts that most costs are incurred regardless of frequency of use. Therefore if one is already paying for a car they often feel it necessary/logical to use it for all journeys (Litman, 2020).

While, as shown above, financial costs will impact one's decision to own a car, a new line of argumentation has recently been introduced. Hess (2022) has found an increase in feelings of joy amongst those who give up their car on their own volition

when it occurs independent of financial concerns. The idea of non-affordability "*car shedding*" is seen to improve subjective well-being.

2.3.4 - Alternative options

While much of the discourse of CD involves reducing car use through disincentivization, it is paramount to offer individuals viable solutions with more sustainable modes (Lavery et al., 2013). A common reason for opting to use a car is the fact that public transport is far less time efficient.

While public transport tends to be financially cheaper, it is often seen as more costly in time, a resource that is becoming far more valuable in today's hardworking society (Woods and Masthoff, 2017, Barker, 2022). The uncertainty surrounding public transport times also adds tremendous stress to a passenger's journey (Tyrinopoulos and Antoniou, 2013). Bates et al. (2001) found reducing variability in journey times to be far more important to passengers than actually reducing travel time.

Tyrinopoulos and Antoniou (2013) found that financial costs rank lowly as a discouraging factor of public transport use. Their results found costs to be of little importance to passengers in comparison to their more pressing issues of reliability, directness, and safety. Their paper concludes by suggesting cities maintain or even increase their fare prices in order to improve the quality of service. Interestingly, the Department of Transport (DOT) in Ireland has just recently decided to cut rail and bus service prices by 20% for all passengers and up to 50% for young people, aged 19-23 (Murray, 2022). While this move has been welcomed by environmental groups, as well as the general public (Bowers, 2022), the aforementioned research does offer some "food for thought" around the Irish government's strategy to encourage public transport use. Therefore, following the logic of this aforementioned research (Tyrinopoulos and Antoniou 2013, Bates et al., 2001), the DOT might perhaps be more successful in improving ridership of public transport by using the public purse to improve the quality of their service instead of offering discounted fares.

2.4 - All in this together?

The decline of planet Earth as a habitable place for humans, animals and plantlife is a well documented crisis that is now on the minds of billions of people across the world. While after many years of debate, there is finally a very widely accepted consensus that the human civilizations current trajectory in regards to energy and resources is wholly unsustainable and as such requires urgent addressing. While the "what?" part of the issue might be argued to be agreed upon, the "how?" and the "who?" issues are subject to uncertainty and blockaded by lack of political will and differing ideas on how the climate emergency should be handled (Hsu et al., 2017).

At this moment in time, people from all walks of life living across the planet are inundated with information and pleas to make dramatic and/or small changes to their lifestyles which will contribute to creating a more sustainable climate for us all. While this challenge is thankfully being taken aboard by swathes of people, the reality remains that individual emissions are not the crux of the issue. Toussaint (2021) explains that 100 private companies are responsible for up to 70% of the globe's greenhouse gas emissions. This daunting fact frequently discourages segments of society from playing an individual role in fighting climate change (Watts, 2022). Furthermore, other subsections of society face more prompt and debilitating problems such as poverty and financial issues which they prioritise over climate action (Hallegatte et al., 2018). For this reason the term "climate justice" has come to the forefront of climate action groups. It is a more equitable approach which campaigns for individuals, countries and private companies to take on the burden of climate issues relative to their rates of emissions and their ability to contribute towards this monumental issue (Sultana, 2022).

The penultimate point of this section is that not all people share the same idea and urgency about taking climate action. While many take their role in fighting climate change very seriously, certain individuals do not view it as their responsibility to tackle these issues, some feel their efforts will always be superfluous in the shadows of powerful governments and organisations, while some do not view it as an issue at all. Research has found that the attitude one holds towards climate issues have a causal and direct effect on their behaviour and likelihood of changing their lifestyle

in order to achieve a more environmentally sustainable outcome (Steg et al., 2016, Blennow and Persson, 2009). This, therefore prompts the question as to how one's culture and attitudes towards issues such as sustainable transport will affect the likelihood of people making eco-friendly choices in how they navigate their cities, towns and villages.

2.4.1 - Addressing the sustainability question

As was previously mentioned, cars, in their current form, are essentially an antidote to achieving a sustainable mobility model. Sustainable mobility involves '*encouraging people to make informed choices about the way they travel and the consequences of those choices on their health and the environment*' (Rogers et al., 2013). It is also associated with the decarbonisation of our transport network. Banister (2008) conceptualised the *sustainable mobility paradigm* to reduce carbon emissions from the transport sector. Like in many sustainable movements, one of its leading pillars is the reduction of consumption. This involves not using high carbon emitting modes, such as cars, in favour of more sustainable modes, such as active travel. While the paradigm insists on the importance of abstaining from carbon intensive modes as much as possible, it also acknowledges issues such as the influencing factors of CD as mentioned in section 2.4.

While cars are a clear hindrance to achieving climate goals, the culture and attitudes surrounding this issue will determine what actions, if any, people will be willing to take to create less polluted and less congested places to live for themselves.

2.4.1 - Electric Vehicles to the rescue?

The rollout of electric (E.V.'s) and to a lesser extent hydrogen vehicles are often mentioned as a key method to tackle rising CO2 emissions. Electric vehicles will provide a much the same product as their dating petrol and diesel relient counterparts but with the major selling point of being much more environmentally friendly. E.V.'s generally release no tailpipe emissions which promises a future of cleaner air in our cities. However, their power source (electricity) is still problematic as it often relies on fossil fuels for its production. Furthermore, the manufacturing of

large vehicles such as cars adds significantly to the carbon footprint of E.V.'s (6 tonnes of CO2, excluding battery manufacturing) (Weiss et al., 2020).

Notably, a commonly overlooked aspect of the emissions released by all motor vehicles, including eco-friendly powered ones, comes from the particles released into the atmosphere from worn tyres and brakes. One researcher suggests that such particles can be up to 1,000 times worse for the environment than what is emitted from an exhaust pipe (Lofthouse, 2020). Nick Molden of Emissions Analytics claimed that tyres are "rapidly eclipsing the tailpipe as a major source of emissions from vehicles," (Carrington, 2022). Particle pollution adds significantly to air pollution which is one of the leading causes of premature deaths in the world, claiming over 7 million lives last year (DW, 2021) This provides for for thought to the relevant leaders and the transport industry as a whole to reconsider its approach of dependency on "carbon free" private motor cars as a solution to the climate crisis.

As of 2021, Ireland had roughly 47,000 electric vehicles out of a total fleet of 2.5 million cars. It is predicted that the number of cars on Irish roads will increase by circa. 155,000 per annum with the national fleet destined to reach 4 million by 2030 (DOT, 2022). The Irish government has invested heavily in the idea of electrictrifying car travel in order to meet its climate goals. They aim to have 845,000 EV's on the road by 2030, however, with less than 50,000 in use at present, reaching this goal in a span of 8 years has left many experts and the general public rejecting or doubting the feasibility of this objective (O'Sullivan, 2022, Hoare, 2022).
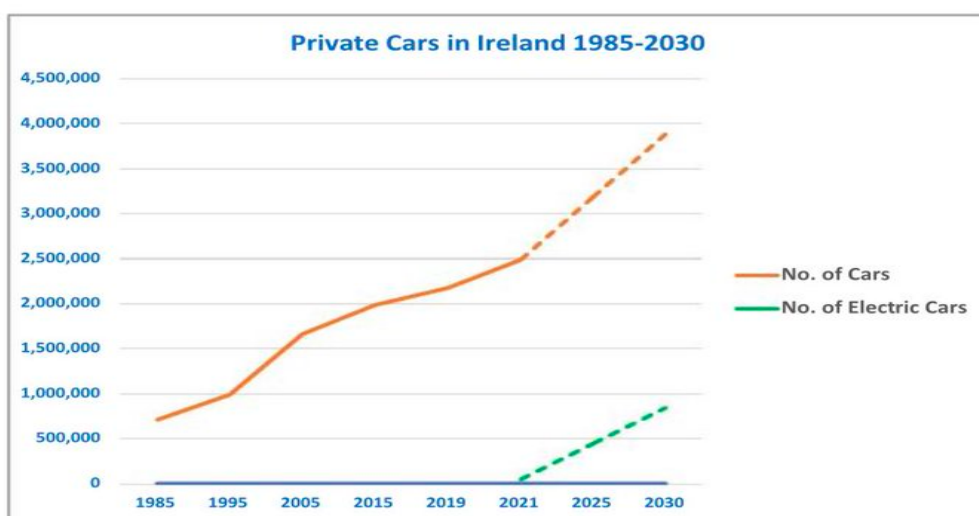

Figure 4: Record of private cars in Ireland (DOT, 2022)

2.4.3 - Not my battle

Now that it has been established that cars are proving problematic to the planet and a barrier to achieving the elusive goal of *net zero* emissions by 2050 (Pye et al., 2017), the attitudes towards sustainable transportation must be taken into account. This will help to understand the car culture that exists across society and will aid the push for a transition to a more efficient transport model.

Research has found that those who are aware of the environmental impacts of their actions are more likely to alter these activities in order to be more eco-friendly (Blennow and Persson, 2009). Furthermore that same paper found a direct correlation between people taking action and those whose livelihoods are being affected by changes to the climate. In Ireland it was found that 70% of people are worried about the effects of climate change and 90% of people understand that human activity is the causal factor. Respondents in the study cited transport emissions as a leading contributor (Timmons et al., 2022).

Timmons et al. (2022) demonstrates that Irish people are supportive of restrictive or discouraging measures (e.g. taxes) on the use of certain products once they understand the negative climatic effects they have on the planet. However, no data appears to exist that the same attitude persists regarding car use. Given the fact that 75% of journeys in Ireland are made by car, Irish people are retaining the idea that their car is a necessity (CSO, 2022). Leading experts in Ireland's transition to a sustainable transport model, Dr Hannah Daly and Dr Brian Caulfield, claim that the Irish public are over-reliant on electric vehicles to mitigate the effects of climate change and that there is a lack of emphasis placed on spurring a paradigm shift away from the current car-centric model (Hoare, 2021).

In summary, the Irish population shows a keen awareness of climate problems and their effects (Timmons et al., 2022). They have also been shown to approve of taking bold steps in order to counteract such issues (Leiserowitz et al., 2021). However, to the best knowledge of the author, there is a lack of evidence to suggest that a willingness exists for people to leave behind the convenience of their car in favour of alternative and arguably more sustainable transport modes.

2.5 - Conceptual Model

The following image offers a visual demonstration of how this research was conducted. This model was based on the studies outlined in the above literature review.
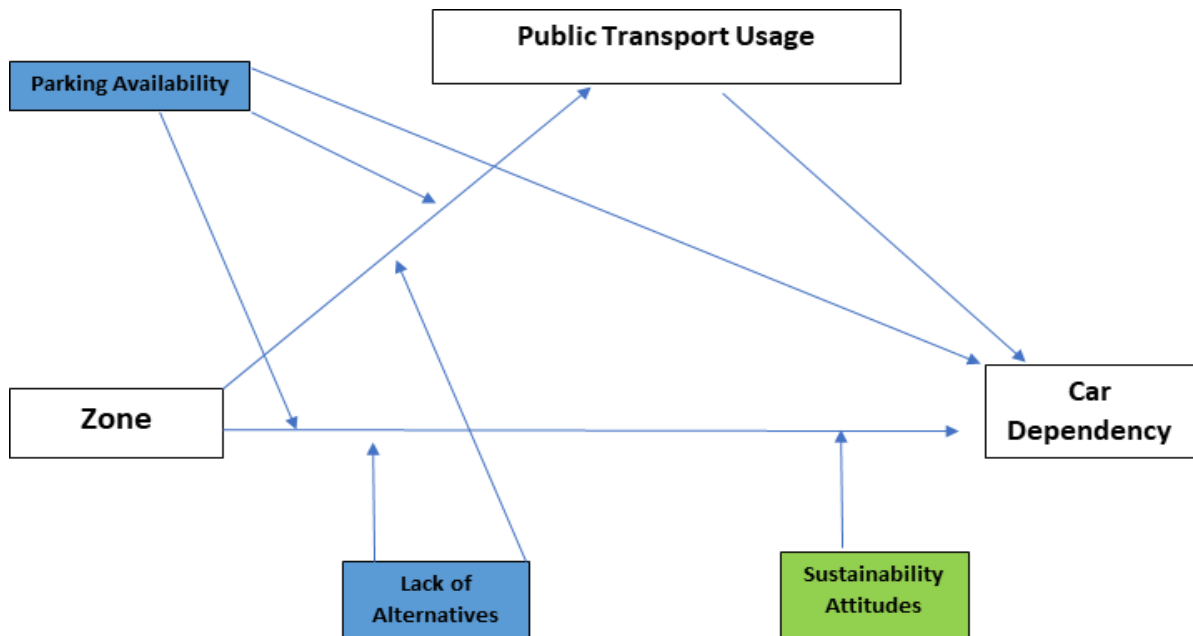
Figure 5: Conceptual Model

This research is based on an array of previous studies on the topic of car dependency. Some of the main concepts covered (i.e. development patterns, parking supply and reduced travel options) are inspired by the *Cycle of Automobile Dependency* model created by Litman (2014) (see figure 1). Further research found that the concept of distance of one's home to a city/workplace or service centre predicting one's decision to drive was confirmed in multiple studies (Larsson, 2020, Cooper et al., 2001, Koning et al., 2020, Van Eenoo et al., 2022). Litman (2014) used the term "dispersed development patterns" to describe this phenomenon. Given the clear strong relationship between distance and car dependency, this element was chosen as a cornerstone for this study.

Furthermore, distance from a centre is frequently linked to less reliable services, especially for public transport and hence people are more likely to travel by car (Zhang, 2006). This phenomenon is frequently linked to areas with low population densities as there are too few people in need of frequent services in order to warrant

the necessary financial investment required (Nigro et al., 2019, Gori et al., 2012). Seeing as Galway is, overall, a low-rise city with considerable urban sprawl (Zhang, 2006a), the research sought to investigate whether such building practices are also contributing to car dependence in the city . By extension, those that use public transport more frequently are less likely to travel by car, especially those that live closer to the centre (Chevallier et al., 2018).

The research also sought to employ interaction effects to expand the knowledge pool on car dependence by understanding to what extent these aforementioned relationships might be effectected or exacerbated by these interactions. The study looked to understand to what extent the built environment/infrastructure, namely car parking availability and a lack of alternative options, might affect one's decision to drive in comparison to holding an understanding of the negative effects car use has on the planet. By understanding these interactive effects it could be uncovered whether people, based in various areas, could be coaxed from their cars by a change in streetscape or by a change in culture, or even both.

Firstly, car parking availability has been cited as a key predictor of car dependence not only by Litman (2014) but across the literature (Stradling, 2003, Hunter et al., 2021, Yin et al., 2018, Guo, 2013). Because of its prominence across the literature and due to the fact that Galway has the highest level of city car parking per capita in the country (Rogers et al., 2013), the author also chose to investigate its effect on car dependence independently of the "zone" variable.

Secondly, prior research has indicated that a poor choice of alternatives to car travel is a primary reason for people choosing to use their car (Zhang, 2006, Tyrinopoulos and Antoniou 2013). Zhang (2006) concluded that ease of use is a key determinant of how people will choose to travel.

Lastly, environmental awareness/concerns often rank as one of the main factors for people when choosing their transport mode, however it is almost never the leading reason (Hopkins, 2016, Stradling, 2007). By implementing this interactive effect (**H8**) it is hoped that the research will uncover the extent to which educational

campaigns around the effects of car use might be effective in transforming a city, which has been sceptical to change, towards a sustainable transportation model.

While, individually, these aspects of the research are well documented (Litman, 2014, Koning et al., 2020, Yin et al., 2018), the interaction effects they play on the respective relationships of this study are underexplored. This research therefore hopes to gain an understanding as to whether the relationship between distance to the city centre and one's car dependency is exacerbated by these aforementioned theories.

Null Hypotheses
H1: Zone of residence did not influence one's car dependency.
H2: Zone of residence had no influence on one's frequency of public transport usage.
H3: The availability of parking at one's work/school had no influence on the relationship between zone and car dependency.
H4: The availability of parking at one's work/school had no influence on the relationship between zone and frequency of public transport usage
H5: The lack of alternatives to car use had no influence on the relationship between zone and car dependency.
H6: The lack of alternatives to car use had no influence on the relationship between zone and frequency of public transport usage.
H7: Frequency of public transport usage did not influence car dependency.
H8: Attitudes towards sustainability did not influence the relationship between zone and car dependency.
H9: The availability of parking at one's work/school did not influence their car dependency

Table 1: Null hypotheses

Chapter 3

Methodology

This chapter looks to outline the research methods that were used as well as how they were employed in order to conduct this study. The research aims to explore the key concepts of CD and attitudes towards car use and alternative transport modes amongst people living in Galway, Ireland. A triangulation was achieved by combining both qualitative and quantitative research methods to offer a comprehensive understanding of CD in the city.

3.1 - Case Study Method

Case studies give a detailed investigation of a specific research entity and can be used independently or as part of a larger study (Gillham, 2000). Using this method facilitates a study to uncover the contextual aspects of CD in the chosen area. The results will also be unique and as such solutions and recommendations can be formed and customised distinctly for the subject, or in this case, city in question. It is deemed to be particularly effective when taking a thorough and explorative look at an issue, event or phenomenon in its natural setting (Crowe et al., 2011). The case study approach is particularly useful when there is a need to obtain an in-depth appreciation of an issue, event or phenomenon of interest, in its natural real-life context (Crowe et al., 2011). Cases can be selected due to their extreme nature or subjective qualities that might make it an interesting subject to study. Urbanism is a social science. This means that laws and general rules are difficult to apply across all cross-sections of society. Studying cities, and their subjective characteristics, can therefore require tailor made research and thereafter, solutions. Case studies in social science research can be very helpful in doing this (Crowe et al., 2011).

This study will focus on the city of Galway on the west coast of Ireland to explore the determining factors of CD in the region as well as the attitudes towards various modes of transport including private cars. As has been outlined in the previous chapters, Galway is a suitable location for this study due to being infamously locked

in a stalemate regarding progressing its transport infrastructure (McGee, 2022, Nevin, 2022). It is therefore an interesting place to gain an understanding as to whether change would be best driven by physical interventions to our cities or if a car culture/ lack of interest in environmental issues is the true barrier to a transport transformation.

Furthermore, Galway is also unique as it continues to be car centric despite it being a small mediaeval city with a concentrated dense central business district (CBD). In contrast mediaeval cities, such as Toulouse, France and Pontevedra in Spain (the latter of which has almost exactly the same population of Galway) have taken strong measures to restrict cars in their centres, favouring active and public transportation instead (Cochoy et al., 2015, Herrmann and Jungwirth, 2022). Despite its street patterns and physical makeup, Galway continues to maintain the status quo. This further highlights the question as to how change could be realised, through a change of culture or a change of streetscape.

3.2 - Hypotheses testing methods

The research first aimed at identifying the travel behaviours of Galwegians within the city, to and from the city and also to and from their place of work/education. Respondents were then asked about their attitudes towards public and active transport, their thoughts on congestion levels and car restrictive measures as well as the parking situations at their homes and places of work/education and how that might affect their decision to drive. Thereafter, an expert was asked to comment on the key findings of the results and to offer their own recommendations on how the city should progress its transport network.

The online survey posed a series of up to 15 questions to each respondent, depending on the answers they gave over the course of the survey. Certain questions included multiple parts to be answered while others gave options to provide unlimited answers, by ticking all boxes if they so wished. The majority of the survey posed multiple choice questions to the respondents. Other questions were measured using an 11 point likert scale. A copy of the online survey can be found in the appendices.

In order to conduct a statistical analysis on the attitudes surrounding sustainability and the environmental impacts of transport mode choice a semantic differential Likert scale was employed (Taherdoost, 2019). This 11 point scale was used to measure opinions and preferences regarding transport. The scale was measured by level of agreeability with each statement put to the respondents. A score of zero indicated "*strongly disagree*" while a score of ten indicated "*strongly agree*". Questions asked were derived from prior research which focused on an individual's subjective measure of car dependency and environmental awareness (Zhao, 2011). Similarly, car dependence was also subjectively measured. Respondents were asked to score themselves using the same scale to decipher how car dependent they were (Zhao, 2011).

Lastly, binary (yes/no) variables were employed to generate variables for parking availability and lack of/barriers to alternatives (see table below).

Zone (GalwayTransport.info, 2012)	Q3: Where in Galway do you live? - 17 options divided into 5 zones - Zones 3,4 and 5 form nominal variable for moderation effects analyses - Division of zones found in Table 3, Section 3.4
Frequency of Public Transport Use (CSO, 2019)	Q7: How often do you use public transport in Galway - 1-2 times per week - 3-4 times per week - At least 5 times per week - Less than weekly but more than once a month - Less than monthly - Never
Parking availability (Christiansen et al., 2017.)	Q12: Regardless of whether you drive or not, how would you describe the car parking situation at your home and your place of work/education? - Parking is FREE and is consistently available for me (and my household/colleagues) - Parking is FREE but my space is not guaranteed - Parking is PAID and consistently available for me (and my household/colleagues) - Parking is PAID but I do not have a space guaranteed to me - No car parking available nearby Binary variable - available/not available

Lack of/barriers to alternatives	Q8 - What do you see as the main barriers (if any) to using public transport in Galway? (Multiple Answers Accepted)
	- Routes do not exist to serve me
	- Routes are not direct enough
	- Routes are not frequent/reliable enough
	- Expensive fares
	- Timetables are unclear/unreliable
	(binary variable, yes/no)
	Q9 - What do you see as the main barriers for you to walk or cycle in Galway (if any)? (Multiple Answers Accepted)
	- Hostile roads/lack of infrastructure
	- Weather
(Anwar, 2009)	(binary variable, yes/no)
Sustainability attitudes	Q6: Please indicate by clicking on the bar chart, to what degree you agree with the following statements. 0 = strongly disagree while 10 = strongly agree. (likert scale)
	- I think about the environmental impacts when choosing my mode of transport
	- I am actively trying to use my car less.
(Zhao, 2011)	- I am interested in reducing my car use.
Car dependency	Q6: Please indicate by clicking on the bar chart, to what degree you agree with the following statements. 0 = strongly disagree while 10 = strongly agree. (likert scale)
	- My lifestyle is dependent on using a car.
	- I don't think about how I travel, I just get in my car and go.
	- I am actively trying to use my car less.
	- I am not interested in reducing my car use.
(Zhao, 2011)	- I would like to reduce my car use but there are no viable alternatives.

Table 2 - Variable measurement scales

In preparation for testing the hypotheses outlined for this research, control variables are first checked for levels of significance. Subsequently a multiple regression is performed with these control variables in order to test for significance. Car dependency is used as the dependent variable. This multiple regression indicated that the control "zone" was significant ($p<.001$) at a 95% level of confidence. The remaining variables: age and gender, were not statistically significant, $p>.05$. Any variables that were shown to be statistically significant could be adopted into further analyses where car dependency is retained as the dependent variable.

Each of the eight hypotheses formulated for this research are tested using multiple regression models. This type of model is useful when looking to predict a variable's value based on the values of others. In this case at least two variables (Rubinfeld, 2000). A multiple regression will allow one to compare and contrast marginal variations in mean values which will in turn demonstrate the strength of the relationship between the dependent variable and 2+ independent variables (Keith, 2019). The testing of hypothesis 1 **(H1),** hypothesis 2 **(H2),** hypothesis 7 **(H7)** and hypothesis 9 **(H9)** were all based on this same logic and as such multiple regressions were used for each of them.

Hypothesis 3 **(H3)** and hypothesis 4 **(H4)** are also tested with multiple regression. However, an interaction effect was introduced to the relationships demonstrated in **H1** and **H2**, allowing the moderating effect of availability of parking at one's place of work/education to be analysed. Hypotheses 5, 6 and 8 **(H5, H6, H8)** follow the same testing strategy (Aiken and West, 1991). H5 and H6 test the same relationships as described in H3 and H4, however the interaction term of parking availability is replaced by a lack of alternatives to the car. **H8** tests the interaction term of attitudes towards sustainability on the relationship between zone of residence and car dependency.

The entire conceptual model is thereafter tested with the PROCESS model 10 by Hayes (2018). This model was chosen as it specialises in studying moderating and mediating effects in order to answer "how" and "when" questions (Hayes, 2018). Such models allow an overall analysis of several independent questions to be conducted in order to see how they interact together. It offers further explanations on the links between statistics and causality (Hayes, 2017).

3.3 - Procedure

This section outlines the manner in which questions were posed to respondents in both the online digital survey and expert interview.

3.3.1 - Quantitative: Online survey

In relation to the quantitative aspect of this research, respondents were asked to participate in a voluntary online survey about car use in Galway city. The questionnaire was created via Qualtrics and could be answered at any time from the 13th of May to the 15th of July. The survey invited people living in the Galway area to take part. Participants were instructed that the survey was anonymous and that they were free to stop participating at any time. Participants were initially met with a brief introductory statement which explained the contents of the survey, who was conducting the research and why as well as how the data was to be used and made available to. Qualtrics was accessed via the University of Groningen's university-wide subscription system. This meant that the university logo was included alongside the introductory message. By using the university logo, the survey's authenticity was strengthened. Ward and Meade (2018) argue that authenticity will increase the likelihood of participants responding truthfully to the questionnaire. Having read the opening statement, candidates were thereafter directed to the survey itself where they could indicate their habits, opinions and preferences to the array of questions posed to them. Skip and display logic were employed to only present questions relevant to the respondent based on their previous answers. A variety of multiple choice, likert scale and open questions were used for the questionnaire. In order to increase participation in the survey, each question was made mandatory to answer (Dooley, 2001). Once a respondent completed the survey they were thanked for their time and a confirmation of their participation being logged was displayed on screen.

In order to document an accurate representation of Galway's population, the survey was primarily distributed with the help of politicians from across the political spectrum. An email was sent out to all councillors in the Galway City Council as well as to every national parliamentarian/Teachtaí Dála (T.D.) representing Galway in Ireland's lower house, Dáil Éireann. Each of these recipients were kindly asked to fill out the survey themselves. They were also invited to share the survey with their followers on Twitter by retweeting a linked *tweet* which was sent from the author's personal account. The survey was also circulated via the author's Instagram and Facebook accounts.

3.3.2 - Qualitative: Expert interview

Upon the completion of the survey data collection process, the research then turned its focus to conducting an expert interview with a local representative or transport expert. The aim was to present the findings of the survey results with the interviewee and to ask how they interpret the results as well as how they believed the challenges presented to them should be addressed.

A semi-structured interview was chosen as the most appropriate means of conducting this aspect of the research. Using a semi-structructured approach allows for a truthful conversation to unfold where the interviewee is able to lead the discussion, within reason (Baumbusch, 2010). This allows the research to gain knowledge about the relevant topics that were not originally seen as central issues (Baumbusch, 2010).

Before meeting, the aim and general discussion points of the interview were divulged to the interviewee. The interviewee had no issues with discussing any of the relevant topics so no alterations had to be made to the interview guide. The interviewee gave prior consent to have the meeting recorded and for their identity to go on the record. They were informed that the recording would be used solely for research purposes, mainly to aid the necessary transcriptions. The interviewee was told that the recording would not be shared with any third party without their prior consent.

The interview was split into seven sections. After once more running through the formalities of the interview process, a positionality of the interview candidate was sought. She was asked to introduce herself, including details such as her name, occupation and address. Thereafter she was asked about her travel habits in Galway city and why she travels with those modes. Subsequent sections posed certain findings from the online quantitative survey to the interviewee to get her reaction as well as whether she viewed such findings as concerning and how she thinks they might be tackled by the Galway City Council. All questions related to topics that were discussed in the quantitative part of this thesis, namely: distance to the centre/density/housing patterns, active transport, public transport, car parking,

sustainability and car dependency. The full interview guide can be found in the appendices.

The interviewee were selected based on their expertise on the issues of this thesis along with their availability and desire to take part. Candidates were contacted via email. All contact information was publicly available on the Galway City Council website, www.GalwayCity.ie, and as such no unauthorised or unwanted contact was made with any interviewee or potential interviewee. Any candidate that chose not to participate was thanked for their response and not contacted again.

Interviews were conducted by video calls via *Google Meets*. While in-person interviews would have been preferred, the distance between the author and the interviewee made this rather problematic. The availability of both parties further exacerbated the problem. The interview was recorded with the help of the Recorder App available on Android. Due to the fact that there was only one expert interview conducted, it was decided that coding the interview would not be necessary. The interviewee was asked for their consent to participate and also to be recorded and quoted for the purposes of this research. A copy of the interview recording will be retained by the author for a period of one year.

3.4 - Survey sample

Through the efforts of the author and with thanks to a very interested and supportive public, the survey managed to garner 851 respondents from across county Galway, a decently representative sample of a city of roughly 85,000 people (CSO, 2016). However, admittedly, this research did experience a relatively high level of survey dropout. While a total of 648 responded to every question posed to them (76.14%), 203 people did not fully complete the survey. 70 (8.2%) completed 6% of the survey, 103 people (12.1%) completed 31% of the questions and 30 (3.52%) responded to 69% of the survey. While this was not an ideal response rate, the research still managed to accumulate a large volume of data from a respectable data set. Investigations were made into why the survey did not manage to engage the participants right until the end. At first, problems with the Qualtrics software were

feared, however, there was no consistency between time and higher incompletion rates, so this was ruled out.

The survey managed to achieve an almost equal balance of male (49.1%) to female responses (49.1% to 49.6%, respectively), while people identifying as either transgender, non-binary/third gender or other made up a small portion of respondents (0.4%).
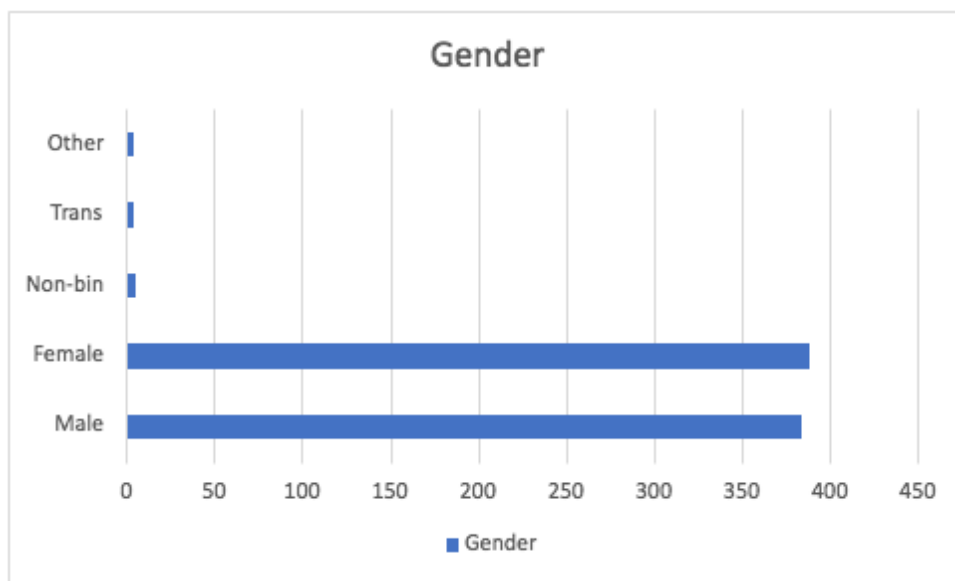
Figure 6 - Gender demographics of survey respondents

Age demographics of respondents were distributed relatively evenly (Jildeh et al., 2021). Only adults (18 years old and over) were asked to participate. When Instagram and Facebook were the primary tools for distributing the survey, the vast majority of respondents came from the 18-24 and 25-34 age brackets. However, once local politicians began to share the survey, the age distribution improved dramatically as can be seen in figure 7.
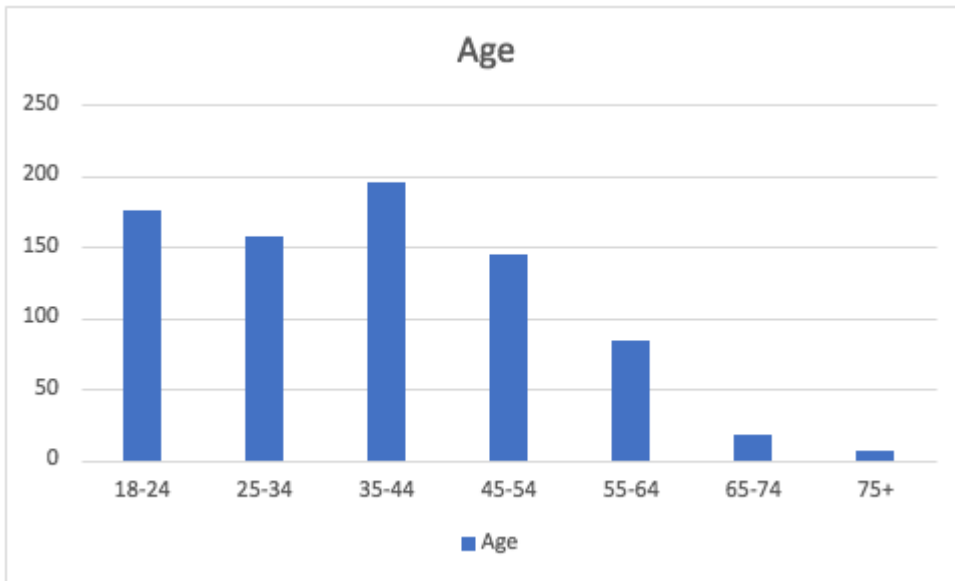
Figure 7 - Age demographics of survey respondents

As previously mentioned, respondents hail from various locations across Galway city and county. The majority of which (75.54%) come from within city bounds as defined by Galway City Council (GalwayTransport.info, 2012). While the remainder (24.46%) live in County Galway.
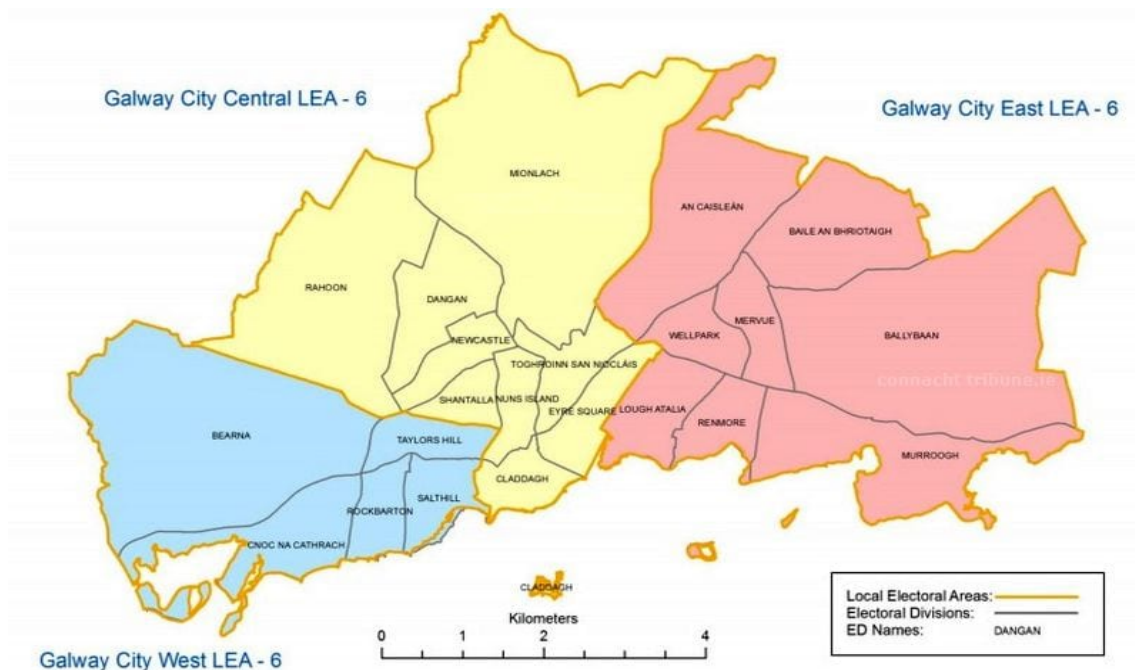
Figure 8 - Galway city boundaries map (Galway City Council, 2020)

In order to conduct this research, the city was divided into 5 separate zones based on their proximity to the city centre. The classification of zones can be seen in the table below. Each zone contains well over 30 responses meaning that the conditions of the

central limit theorem have been met (Kwak and Kim, 2017). Zone 1 contains the city centre, zone 2 locations are all within a 3.5 km's radius of the city centre. Zone 3 locations lie within 5.5 km's of the centre while zone 4 is within 8.8 km's of the centre. Zone 5 includes all other responses from locations outside of the city bounds.

Zones	Locations	N	%
Zone 1	City centre	67	8.58%
Zone 2	Salthill/Claddagh, Renmore, Westside/Shantalla/Rahoon, Terryland/Ballinfoyle area, Newcastle/Dangan, Mervue, Wellpark	308	39.44%
Zone 3	Knocknacarra, Doughiska/Roscam, Ballybane/Ballybrit, Castlegar	155	19.85%
Zone 4	Bearna, Oranmore	60	7.68%
Zone 5	Galway County	191	24.45%

Table 3 - Location of zones. Zones 3, 4 and 5 make up nominal variables for moderating effect analyses.

Finally, the participants of the survey claimed to use a variety of modes of transport when travelling to the city centre and their place of work/education. The most popular mode of transport for both types of journeys was the private car, either as a driver or passenger. 59.5% of respondents indicated that they use a car in some capacity in order to reach the city centre (see figure 3). While 58.8% used a car to commute to their place of work/education.

Mode Choice

other
1.2%

cycle
11.3%

walk
18.4%

train
1%

bus
8.6%

car(
passe...
4.7%

11.3%

18.4%

8.6%

car(
driver)
54.8%

54.8%
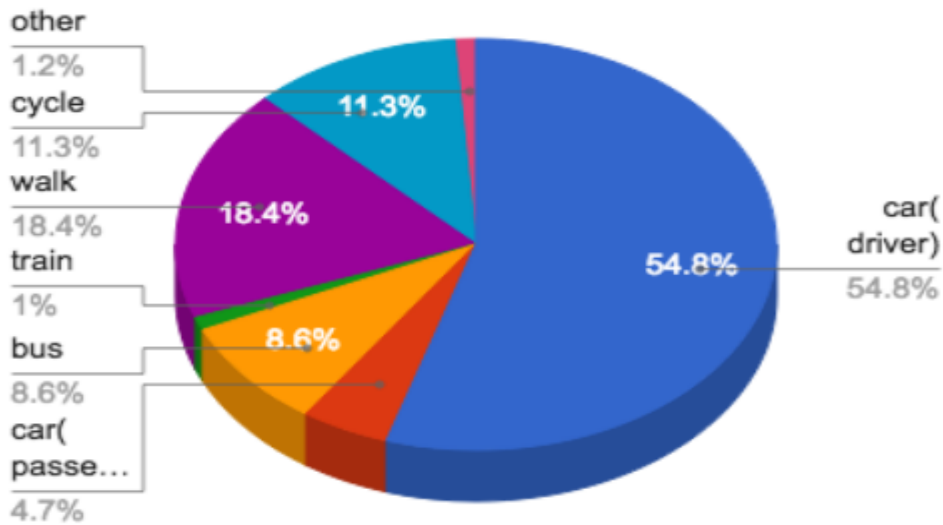
* 59.5% use a car to access the city centre.

Figure 9 - Pie chart indicating transport mode choice to reach Galway city centre.

With regards to public transportation usage, the respondents generally used the bus or train either never or rarely. Few respondents were heavily reliant on public transport services (see figure 10).
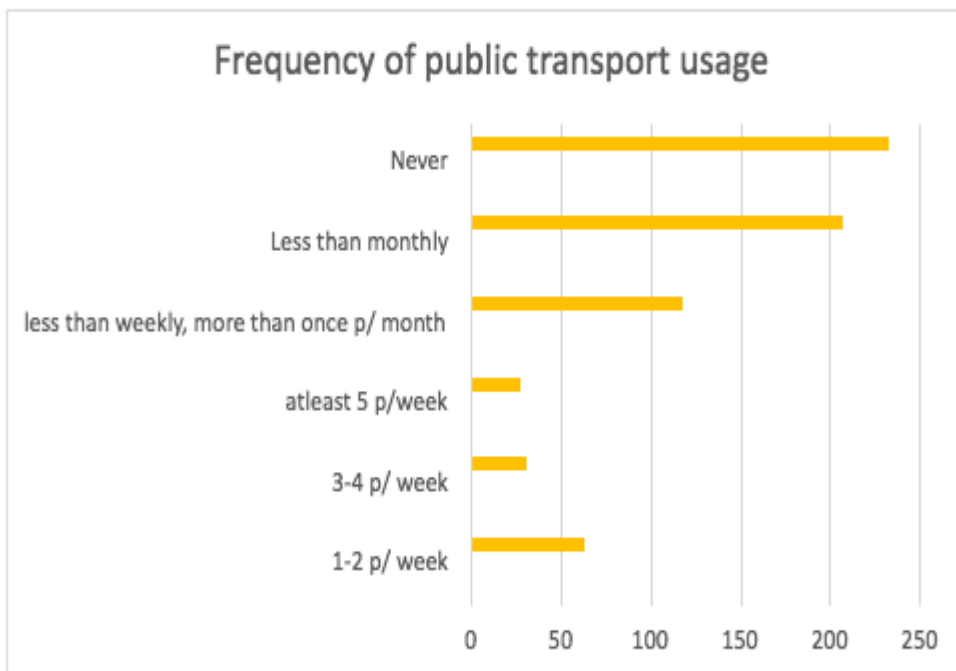

Figure 10, Public transportation usage in Galway city.

An opportunistic survey was employed to collect this data and therefore generalisations and comparisons to the broader population cannot be made as their responses were of course not available to the author.

3.5 - Positionality of Expert

This study looked to include a qualitative element via an expert interview in order to make a comparison between the main findings of the online survey and the current policies of senior local politicians. This allows for the research to comment on how the opinions and intentions of politicians are serving the interests of their electorate. It also brings an honest conversation about the city's future in transport to light.

As was mentioned in section *3.3.2*, potential candidates for the interview were kindly asked to participate in the research based on their proximity to decision making regarding Galway's transportation. For this reason senior politicians who serve on the Galway City Council as well as senior traffic engineers directly employed by the same council were approached. After engaging with various potential interviewees, Councillor Colette Connolly was selected and formally invited to take part in a semi-structured online interview.

Councillor Connolly is a well respected and long-serving local politician who has served on the Galway City Council for 18 years, having first been elected to the role in 2004 (Finnegan, 2022). Colette Connolly is a representative of Galway City Central ward with an address of Shantalla, close to the city centre. For the purposes of this research, Shantalla is deemed to be in Zone 2. The interviewee is an independent public representative. She is not a member of or affiliated with any political party.

In 2021 she was elected as the Mayor of Galway. She served the standard one year term until June 2022 when her title was handed to Councillor Clodagh Higgins of the Fine Gael party (Finnegan, 2022). Over the course of her tenure as Mayor, the council discussed numerous plans relating to transport, most notably: the Salthill cycleway and the city ring road. Councillor Connolly was an advocate of the cycleway's construction, however, she opposed the plans presented for the city ring road (Sassone, 2021).

Her dealings, as Mayor, with such topical projects makes her a prime candidate for an expert interview as part of this research.

3.6 - Ethical Concerns

This thesis aims to give a truthful and unbiased representation of how the people of Galway move throughout the city and how they choose their mode of transport. Furthermore it also looks to learn how policy makers believe these results should be interpreted and addressed as well as how the challenges and opportunities they see in moving away from a car dependent transport network. Being from Galway allowed a greater understanding of the city's structures and the difficulties faced by the people of Galway as well as the general attitude towards cars and alternative modes.

The survey promised absolute anonymity to all of those who chose to participate. Anonymity is a cornerstone for this kind of research method and it is important to uphold this to encourage increased participation and honest responses (Tourangeau, 2018, Schomakers et al., 2020). This principle was not adhered to for the purposes of the expert interview as it would have impeded transparency around the status and positionality of the chosen experts (Saunders et al., 2015).

The study made all efforts to ensure that all questions were phrased appropriately. This was ensured by focusing on using questions that were previously used by other well-respected studies. The distribution of the survey, as stated in section 3.4.2, was spread to as many people from across the political spectrum as possible.

The research has no links to economic or political interests regarding car use and the interviews did not aim to promote a particular mindset/ideology nor did they aim to uncover compromising results or to provoke controversy. The interviewee was selected based on their expertise and proximity to the issues at hand as well as their availability/desire to take part in the study.

The positionality of the author is based on a curiosity to create sustainable transport networks which will benefit the environment, social issues and public realm. The author is also a member of the Galway Cycling Campaign. Any potential bias was removed by ensuring people from all paths were involved in the collection of data as well as posing appropriate questions in both the surveys and expert interviews. The ultimate aim of this study was to obtain an accurate description of the truth regarding car use in Galway.

Chapter 4

Results

Chapter 4 attempts to summarise the main findings of both the online survey and the expert interview. Firstly, assumptions for performing regressions as part of the quantitative analysis are tackled. Thereafter, the chapter reveals the results which were derived from the SPSS analysis and then the qualitative expert interview.

4.1 - Quantitative analysis assumptions

In order to begin testing and analysing the declared hypotheses outlined in chapter 3, the assumptions for the relevant tests must be satisfied (Zach, 2022). The assumptions of normality, linearity, independence and homoscedasticity are required when performing regressions, both linear and multiple (Osborne and Waters, 2002, Schmidt and Finan, 2018). It is also essential to show that multicollinearity is not problematic to the analysis procedure. Multicollinearity is where several independent variables in an analysis are correlated. This had to be avoided as it could have led to biased estimates (Paul, 2006). All models displayed variance inflation factors (VIF) below 2.5 meaning that there may be moderate correlation but it is wholly unproblematic (Everitt and Skrondal, 2010) (see table 4).

Normality was assessed with the help of the normal P-P plot (see figure 11). This plot found that all residuals of the analysis lied, in general, around the line of normality with only minor deviations seen. Residuals, in this case, are defined by Ipurangi (2022) as "*the difference between an observed value of the response variable and the value of the response variable predicted from the regression line*".
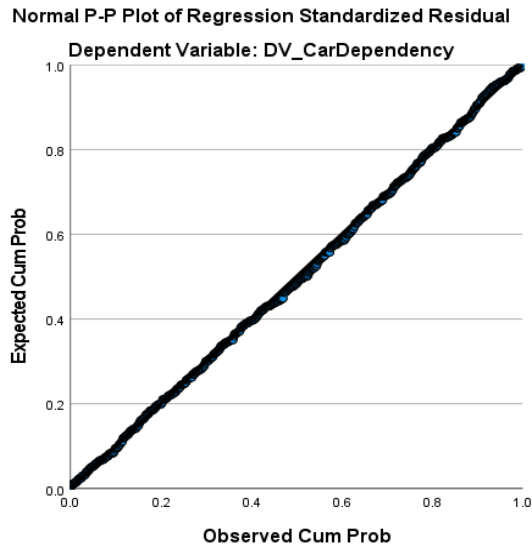
Figure 11: P-P plot to assess normality (Model 1 - zone and car dependency)

The presence of homoscedasticity was also tested by analysing the relevant scatter plot (see figure 12). This determined that the variances of comparative groups were similar. Residuals were found to be evenly distributed along the scatter plot, therefore proving homoscedasticity to be present. Finally, independence is more difficult to achieve and to demonstrate as it is. However, with a sample size as large as this study has ensured a satisfactory level of independence.
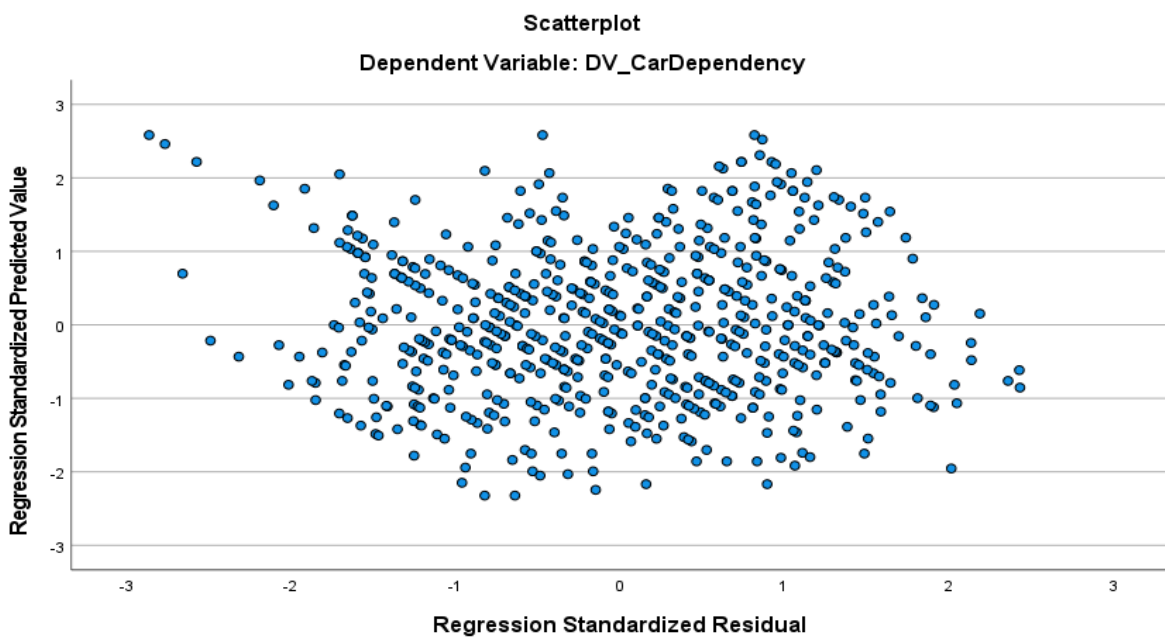
Figure 12: Scatterplot to assess homoscedasticity (Model 1 - zone and car dependency)

Linearity is implied whereby a linear relationship exists between each of the independent variables and the dependent variable. This was verified by using scatter plot graphs. Linearity could also be satisfied when normality, independence and homoscedasticity were proven as it means that predictor variables share a straight-line connection with the result variable (Malhotra, 2020).

Concerns over reliability were taken into account. Sphericity was tested for by using the Keyser, Meyer-Olkin (KMO) test for sphericity. KMO found sample adequacy for each model with each outcome greater than .7. Therefore sphericity is unproblematic (Shrestha, 2021).

Model	Sphericity value (KMO)	Variance Inflation Factor (VIF)
1	0.77	1.010
2	0.81	1.222
3	0.75	1.033
4	0.91	1.013
5	0.84	1.055
6	0.79	1.090
7	0.71	1.001
8	0.88	1.008
9	0.84	1.230

Table 4: Sphericity and variance inflation factor values

4.2 - Quantitative analysis results

This section provides the outcomes for all of the statistical tests performed on each hypothesis of this research. The 9 hypotheses are tested with regression models while the final conceptual model itself is tested with a PROCESS model 10 as demonstrated by Hayes (2018).

Table 3 - Overview hypotheses results

	Hypothesis	Model 1 DV=CD	Model 2 DV=PT	Model 3 DV=CD	Model 4 DV=CD
	Direct effect (H1, H2, H7, H9)				
Main variables Zone	*H1, H2*				
Reference: Zone 1	*Zone 2*	.030 (.032)	.043 (.024)		
	Zone 3	.047.* (.026)	.051* (.018)		
	Zone 4	.071*** (.019)	.060** (.012)		
	Zone 5	.089*** (.025)	.065*** (.013)		
PT usage	*H7*			.492*** (.055)	
Parking	*H9*				-.151* (.066)
Control variables Age		.117 (.064)			
Gender		-.025 (.156)			
R squared		.096	.028	.109	
R squared (adjusted)		.094	.026	.108	

	Hypothesis	Model 1 DV=CD	Model 2 DV=PT	Model 3 DV=CD	Model 4 DV=CD
	Moderation (H3, H4)				
Main variables Zone		.099* (.041)	.043** (.010)		
Parking		-.151* (.066)	.616 (.416)		
Interaction effect Parking * Zone	H3, H4	-0.001 (.041)	-.048 (.045)		
R squared		.110	.035		
R squared (adjusted)		.106	.027		
	Moderation (H5, H6)				
Main variables Zone		.540* (.128)	.070 (.047)		
Alternatives		.858 (.948)	.365 (.443)		
Interaction effect Alternatives * Zone	*H5, H6*	.127 (.673)	.044 (.048)		
R squared		.124	.042		
R squared (adjusted)		.118	.034		

	Hypothesis	Model 1 DV=CD	Model 2 DV=PT	Model 3 DV=CD	Model 4 DV=CD
	Moderation (H8)				
Main variables Zone		.099*** (.012)			
Sustainable		-.158*** (.010)			
Interaction effect Sustainable * Zone	*H8*	-.150*** (.009)			
R squared		.283			
R squared (adjusted)		.282			

Note: *p<.05, **p<.01, ***p<001. Standard Errors are reported in parentheses.

In the analysis of the H1 and H2 models, where ordinal variables were employed, it was found that zones 1 and 2 showed no significant difference. As a result, it was decided to combine the remaining zones (3, 4 and 5) into a binary/nominal variable for the remaining relative interaction effect models (H3, H4, H5, H6, H8). This helped to simplify the analysis while also focusing on the areas most affected by the zone variable.

When presented as a nominal variable the overall model for the zone found that living in these zones share a statistically significant relationship with car dependency, B= .119, t(648)=8.283, p<.001. Similarly, significance was also found when testing the relationship between these zones and public transport usage B=.043, t(648)=4.294, p<.001.

Herein (excluding H1 and H2), references to zones of residence apply specifically to zones 3, 4 and 5.

H1 - Zone of residence had an influence on car dependency

The first hypothesis of this research tested whether the zone in which one resided affected their level of car dependency. Results of the statistical analysis show that one's zone of residence is a significant positive predictor of being car dependent, as defined by this research. Zones radiate from the city centre. Those that live in zones further from the centre were found to be significantly more car dependent than those residing closer to the city. This result is reflected in the overall model which was also found to be significant $F(1, 648) = 68.607$, $p<.001$. Variance could be explained by an R squared value of .096 which when adjusted was .094.

Furthermore, the zones were also analysed individually using zone 1 as a reference for other zones to be compared to. Each zone, with the exception of zone 2, was found to be significantly different regarding car dependency. Results for each zone are displayed in the table above.

As a result, it can be concluded that the zone in which one lives positively influenced their level of car dependency. Therefore the research could reject hypothesis 1. It should be noted that each zone is not necessarily more car dependent than the next. However, distance from the centre is, overall, a useful predictor for car dependence.

H2 - Zone of residence had an influence on rate of public transport usage

The second alternative hypothesis (**H2**) predicts that the zone in which one resides affects one's public transport use rate. Statistical significance was determined for the overall model, $F(1,648) = 18.442$, $p<.001$. Variance in the modelling is explained by the R squared value of .028 and when adjusted it equaled .026.
This determined that those living in zones further from the city centre were significantly more likely to use public transport more often than those living more proximate to the centre.
Like H1, this model also used zone 1 as a reference in which to compare other zones. It also found significance for each zone with the exception of zone 2 which was found to have a similar level of public transport usage as zone 1 (see table).

In summary, one's zone of residence in Galway is, overall, a good predictor of one's frequency of public transport use. Therefore, the research fails to reject hypothesis 2.

H3 and H4 - Moderating effects of the availability of car parking

H3 - The alternative hypothesis for **H3** predicted that the availability of car parking at one's place of work/education could strengthen or weaken the effect that one's zone of residence has on their level of car dependency.

An interaction term was added to the model described under hypothesis 1 (the relationship of parking availability at one's zone of residence and their place of work/education). The change in this model produced significant results $F_{(2,646)}$ = 5.127, p=.006. Associated variance can be attributed to the R squared value = .110. The adjusted R squared value=.106. However further analysis demonstrated that the interaction term of car parking availability did not prove to be significant, B = -0.012, t = -0.286, p =.775. The statistical improvement in the model can be attributed to a significant direct effect of parking availability on car dependency, B = -.207, t = -3.046, p=.002.

To conclude, the availability of car parking did not significantly moderate the relationship between zone of residence and one's car dependency. As a result, the research rejects hypothesis 3.

H4 - Much like the above, hypothesis 4 was used to test whether the availability of car parking at one's place of work/education strengthens or weakens the effect that one's zone of residence has on their frequency of public transport usage. It was found that including an interaction term between zone and parking availability did not significantly improve the model, $F_{(2, 646)}$, =11.13, p = .325. The additional variance explained was just 0.35 and adjusted to .027.

Furthermore, the interaction plot failed to find results to suggest an enhancing or disenhancing effect on the relationship, B=-0.05, $t_{(648)}$ =-1.01, p=.313. With an adjusted R squared value of .027, the relationship between zone of residence and public transport usage was neither strengthened or weakened by the availability of parking at work/school.

The research concluded that the coefficient of the interaction term was insignificant and so availability of car parking at one's workplace/school had no moderating role

on the relationship between the zone of one's home address and their public transport ridership behaviour. Therefore, hypothesis 4 could not be rejected.

H5 and H6 - The moderating effect of the lack of alternatives to using a car (as a driver or passenger)

Here the alternative hypothesis **(H5)** predicted that a lack of existing alternatives to car use would strengthen or weaken the relationship between one's zone of residence and their car dependency. This model proved to be statistically significant, $F(2,644) = 5.370$, $p=.005$. R squared$= .124$. This value equals $.118$ when adjusted. However, the interactive element of the lack of alternatives on the relationship did not find significance, $B=.078$, $t(644)=1.140$, $p = .255$. It can therefore be stated that the lack of existing alternatives to car use did not affect the relationship between one's zone of residence and their car dependency. Resulting in the research failing to reject hypothesis 5.

Hypothesis 6 measured whether a lack of existing alternatives to car use significantly affected the relationship between zone of residence and their public transport usage. Adding the interaction term led to significant improvement in the model, $F (2,644) = 3.562$, $p = .029$. Variances are explained by the R squared value of $.042$. However the interaction term of, lack of alternatives to car use, itself was found to be non-significant, $B= .044$, $t(644)= .916$, $p = .360$. The adjusted R squared value was equal to $.034$. In conclusion hypothesis 6 could not be rejected.

H7 - Frequency of public transport usage influenced car dependency

Hypothesis 7 tested whether one's frequency of use of public transport in Galway predicts one being car dependent. The findings were statistically significant, $F(1,648) = 79.421$, $p<.001$. R squared was $.109$ and when adjusted was $.108$. It was found that frequency of public transport usage had a direct negative effect on one's car dependency, $B= .492$, $t = 8.912$, $p < .001$. As would be predicted, the more often one used public transport, the less dependent on using a car they were. With these P values significance was found at a 99.9% level and therefore hypothesis 7 can be rejected.

H8 - The moderating effect of awareness of car related environmental and social issues

This final hypothesis (**H8**) looks to test whether being aware of the environmental issues surrounding car use as well as their implications on society such as traffic, moderates the relationship between zone of residence and level of car dependency. This hypothesis could not be rejected due to a significant result, $F(1, 648) = 255.642$, $p<.001$. The analysis found R squared to equal .283, while R squared adjusted equaled .282.

Furthermore, one's attitudes towards sustainability had a direct negative effect on one's car dependency, $B= -.158$, $t (648)=-15.989$, $p<.001$.

Therefore, H8 is rejected as those who are more aware and conscious of these aforementioned issues are less likely to be dependent on their car in Galway.

H9 - Availability of parking influenced car dependency

While H3 and H4 failed to show significant results. H9, measuring the direct link between car parking availability at one's place of work/education and car dependency, did confirm a predicting effect, $F(2,646) = 5.127$, $p=.006$. R squared=.110 and when adjusted=.106. According to the analysis, $B = -.207$, $t = -3.046$, $p=.002$. Therefore, the research fails to reject H9, indicating that the availability of car parking at one's work/education is a worthy predictor of car dependency in Galway.

Overall Model Analysis

Finally, the entire conceptual model produced in section 2.6 was tested altogether with PROCESS model 10 (Hayes, 2018). All results are analysed and interpreted at a 95% confidence interval. 5000 bootstrap samples were employed for this model.

Contrary to the results of the initial individual analyses, the results of this model were all found to be insignificant, with exception of one. Frequency of use of public transport was significant (coeff.=.4104, p=.0000). A discussion on this complex model can be found in chapter 5.

Hypothesis	Coefficient	P value
H1: Zone of residence influences their car dependency.	.0770	.2326
H2: Zone of residence influences their frequency of public transport usage.	.0699	.1358
H3: The availability of parking at one's work/school influences the relationship between zone and car dependency.	.3731	.5136
H4: The availability of parking at one's work/school influences the relationship between zone and frequency of public transport usage	.6031	.1464
H5: The lack of alternatives to car use influences the relationship between zone and car dependency.	.4564	.4534
H6: The lack of alternatives to car use influences the relationship between zone and frequency of public transport usage.	.3646	.4103
H7: Frequency of public transport usage influences car dependency.	.4104	.0000
H8: Attitudes towards sustainability issues influences the relationship between zone and car dependency.	-.0012	.9842
H9: The availability of parking at one's work/school influences their car dependency	.0592	.3675

Table 6: PROCESS Model 10 results

4.3 - Qualitative analysis results

Following on from the quantitative analysis, a qualitative analysis aimed to expand on from these findings, focusing on the political and policy aspects of the issues at hand. Results were gathered via a 45 minute semi-structured interview with former Galway city Mayor, Councillor Colette Connolly. This section has multiple points of analysis. Topics discussed with the expert include: their personal travel habits in Galway and what affects their choices, how they view the overall transport network and whether they believe change is required.

4.3.1 - Expert interview results

In the expert interview, Councillor Catherine Connolly expressed a clear and profound dissatisfaction with the current state of Galway's transport network. Connolly described the city as "completely car dependent" and yearned for a change to the current system. While she showed an unhindered love for the city, she also displayed a deep frustration with those who staunchly refused change, amongst them politicians, council engineers and members of the public.

> *"Galway is the most beautiful city, if only it were planned in the right way"*

Connolly stated that she was a pedestrian, cyclist and a motorist. She rarely uses public transport. She preferred to walk to the city, however, she felt stipulated to drive to work as her work in the council requires her to bring a lot of heavy documentation to meetings. However, in her second job as a teacher, she would choose to walk. While walking was her preferred mode, she also cited the issue of parking availability as a reason not to drive.

Connolly described the current transport model as "disastrous". She reiterated her view that plans were consistently developed with the car at the centre. She believed any vision for a change to this model was at the discretion of the council engineers whom she believed had no appetite for such a shift.

Zone/Density (H1, H2)
The councillor was told about the survey findings of this research regarding the impact distance from the centre had on car dependency i.e. that those living further from the centre were significantly more car dependent. In turn the question of increasing densification was posed to the interviewee. While the councillor understood the impacts of distance on car use in the city Connolly declared that she is not the greatest advocate of high rise densification. She insisted that we should not strive to replicate Dublin's high rise policy in the docklands. She also expressed great dismay over recent developments in the Salthill area, which she labelled

"monstrous". She did, however, support densification "contingent on a sustainable transport model". She described how she clashed with a government party's plans for densification where bus routes did not exist or were not yet planned. Connolly also believed that such high rise developments would not aid a fight against car dependency as planners continue to insist on minimum parking requirements (one space per dwelling) which Connolly claims only exacerbates the problem.

Connolly conceded that distance did indeed influence car dependency, vindicating the suspicions of this research (rejecting **H1** and **H2**). However, she did not see densification as a means to reduce commuting distances as a silver bullet to car dependence in Galway.

Parking (H3, H4, H9)

The survey finding of car parking availability at one's place of work/education predicting car dependency came as no shock to the councillor. While the former mayor found it difficult to comment on the interaction effects, she said in no uncertain terms that generous parking provision in locations around the city, including places of work/education, is most definitely promoting a car dependent culture in Galway. Her comments demonstrated a clear rejection of hypotheses 3, 4 and 9.

Connolly was adamant that a city such as Galway needed to dramatically decrease its car parking availability. In particular she took issue with the existence of loading bays, such as on Eglinton Street, which are being abused by people parking in order to use nearby shops or services. She made the comparison to the city of Lorient (a twin city of Galway) which allows (un)loading for 10 minutes. She claims this system works due to a mix of monitoring and respect for the rules, which she believes is lacking in Galway.

Connolly says that she is consistently campaigning for a reduction in parking in the city centre. However, in turn she has been called "mad" and a "fascist" by fellow councillors and the general public.

"Everytime you say this [to reduce parking], people call you a fascist"

When asked whether she supported the multiple free car parking areas dotted across the city, Connolly took no issue. She instead persisted that while parking should be decreased, free parking can be provided for those who need it, but it must be respected and not abused. She saw the availability of parking to have a greater influence on car use than the cost of parking. However, Connolly believes that parking fees, where they exist, should be increased to levels in line with European counterpart cities. She claimed it would provide extra funds to the council. This notion, she said, was struck down by fellow councillors who claimed such measures would "hurt the worker".

Alternative/Public transport (H5, H6, H7)

Connolly also showed dissatisfaction with the current public transportation system. She claimed that she would not take the bus mostly due to anti-social issues on the network. She cited multiple recent incidents of violence on the network including an incident involving a family member.

Furthermore, Connolly criticised NTA plans for future bus routes which she said all passed through the city centre. She called for a bus link between west and east Galway which would help people to commute from residential to industrial/commercial areas. She criticised the lack of a bus route over the Quincentennial Bridge, a road which bypasses the city centre. Connolly said she could understand why ridership was found to be as low and infrequent as was demonstrated by the survey. She believed that bus routes needed to be running at ten minute intervals or less in dedicated bus lanes that are not obstructed by parked or loading vehicles. Connolly called for locations where 2 lanes of car traffic are provided to have one lane repurposed as a dedicated bus lane.

Connolly also expressed concern over the placement of bus stops at major amenities such as the University College Hospital and the Gateway Shopping Centre. In both examples people are expected to travel through vast car parks in order to reach a bus stop (see figure 4.3.1).

Figure 13 - Map of the Gateway Shopping Centre, Knocknacarra. The bus stop serving the centre can be found on the road between the green spaces entering/exiting the shopping centre in the centre foreground of the picture. (Property.ie)

Active transport

As a keen walker and cyclist, Connolly showed a visible interest in this subject. Councillor Connolly did not have any praise for the current state of infrastructure regarding active transport. She shared the sentiment of the online survey by declaring that hostile roads and a lack of infrastructure to be the primary barrier to walking or cycling in Galway city.

Connolly was most concerned with the state of footpaths in the city. She shared incidents of abusive drivers and cyclists who violated the rules of the road. The councillor campaigns for wider footpaths in order to coax people out of their car. Connolly claimed many of her constituents were driving less than 1km to drop their children to school. She described an almost reinforcing cycle of cars parking on footpaths which made walking dangerous, forcing even more people to drive.

In summary, Connolly identified major issues with both public and active transport which she believes contribute significantly to people's decision-making process to use

their car, rejecting hypotheses 5 and 6. Her comments also aligned with the survey findings regarding H7, indicating that a high level of public transport use will result in a less car dependent lifestyle.

Sustainable Attitudes (H8)

The interview then shifted to the area of sustainability and how Connolly believes Galwegians view the issue. This led to a lengthy conversation about the attitudes Galwegians, and Irish people overall, have towards their environment and the rules in place.

Connolly was told about survey results which found how awareness and concern for sustainability issues predicted less car dependent lifestyles. She was then asked if she herself believed that Galwegians took environmental issues into account when choosing their mode of transport. Connolly acknowledged the survey results but said she was sorry to say that she did not believe that was the case at all, accepting the null hypothesis of **H8**. She said that people could be "positively selfish" when choosing how they travel and how they abuse their mode.

Given the semi-structured layout of the conversation, Connolly was allowed to go on to speak about the role organisations, businesses and individuals play in weaning broader society from car dependency. Connolly showed a deep anger towards institutions such as the universities, schools, churches and sports clubs who she claims "turn a blind eye" to inherent rule breaking while promoting car centric infrastructure. She stated that the universities have created parking which has encouraged students and staff to commute by car. According to Connolly the parking location of NUIG's "park and ride" is in the city centre and is therefore superfluous in tackling congestion. Connolly proceeded to criticise sports institutions and clubs who fail to prioritise public transport as well as churches for failing to ask their parishioners to follow the rules of the road when parking. Furthermore, she attacked An Garda Síochána (police) for paying no attention to "reckless" driving habits even when formal complaints are made.

In all, Connolly simply believes that the Irish public and key organisations do not care to tackle car dependency issues. She claims that many Irish people are "wedded

to the cars" and that, in general, they do not see the "connections" between everyone wanting to drive and the resulting issues of congestion and pollution. Connolly stated that many people feel they have a "God given right" to use their car to travel everywhere. She also spoke about constituents of hers lobbying her to scrap plans to improve public transport access. Connolly stated that she has stopped advocating for bus shelters due to complaints from residents who claim they attract anti-social behaviour. In summary, Connolly does not believe the people of Galway care to sacrifice the convenience of a car for a sustainable transport network.

The interview came to end by raising the fact that there is a political wave transforming European streets by improving public realm, road safety and prioritising alternative transport modes (Hernández-Morales, 2022, Limb, 2022). Connolly was asked what it would take for Galway to undergo a similar transformation. The councillor believes that it could take the death or serious injury of a child in order to induce such a radical change. She believes that the looming issues of climate change will do nothing to coax people from their car. She also said that "Irish people only understand money" as she suggested that change will only realistically occur once economic impacts dictate it.

Chapter 5

Conclusion

This final chapter looks to discuss the results which were presented in chapter 4 of this research. Furthermore, the chapter seeks to identify the main implications of these results for Galway (5.2) and offer recommendations for how Galway might adopt a more sustainable transport model (5.3). The limitations and suggestions for future research are discussed in 5.4 and 5.5, respectively.

5.1 - Research scope

This thesis set out to investigate how car dependency is enabled and/or effected by the utility of cars and other transport modes as well as how awareness of sustainable issues influence car use. This was achieved by the framework laid out in the conceptual model which sought to examine: 1) the effect distance of one's home from the city centre had on their car dependency as well as 2) the effect their frequency of public transport usage had on their car dependency levels. Supplementary to this, the moderating effects of availability of parking, lack of alternatives to car travel and attitudes towards sustainability were examined. This section relays the findings of the hypotheses as well as how they compare to other relevant studies performed in the past. A summary of the main findings of the quantitative analysis can be found in *table 4* below.

Hypothesis	Result
H1: Zone of residence did not influence one's car dependency.	**Rejected**
H2: Zone of residence had no influence on one's frequency of public transport usage.	**Rejected**
H3: The availability of parking at one's work/school had no influence on the relationship between zone and car dependency.	Failed to Reject
H4: The availability of parking at one's work/school had no influence on the relationship between zone and frequency of public transport usage	Failed to Reject
H5: The lack of alternatives to car use had no influence on the relationship between zone and car dependency.	Failed to Reject

H6: The lack of alternatives to car use had no influence on the relationship between zone and frequency of public transport usage.	Failed to Reject
H7: Frequency of public transport usage did not influence car dependency.	**Rejected**
H8: Attitudes towards sustainability did not influence the relationship between zone and car dependency.	**Rejected**
H9: The availability of parking at one's work/school did not influence their car dependency	**Rejected**

Table 7: Hypotheses results for quantitative study

5.2 - Quantitative discussion and academic implications

The research could reject the first hypothesis **(H1)** as it was found in both the quantitative and qualitative analysis that the zone in which one resided could be a positive indicator for one's level of car dependency. This meant that those living further from the centre of Galway were significantly more likely to depend on a car for travel. While an increase in distance might be seen as a reasonable indicator for increased car dependency, it is important to note the scale of the case study in question. According to *Google Maps* and the *Galway Cycling Campaign* (see figure 14 below), it is possible to travel from the furthest city zone (zone 4), to the city centre in 17-24 minutes by car or ~30 minutes by bike. Closer zones are only marginally closer in time. For example, one can travel from zone 3 to the city centre in 15-19 minutes by car or ~18 minutes by bike.

The idea of distance predicting car dependency is a topic which has been discussed in prior research (Larsson, 2020, Koning et l., 2020, Van Eenoo et al., 2022, Cooper et al., 2001). Such studies have been the bedrock for campaigns calling for further densification of our urban areas.
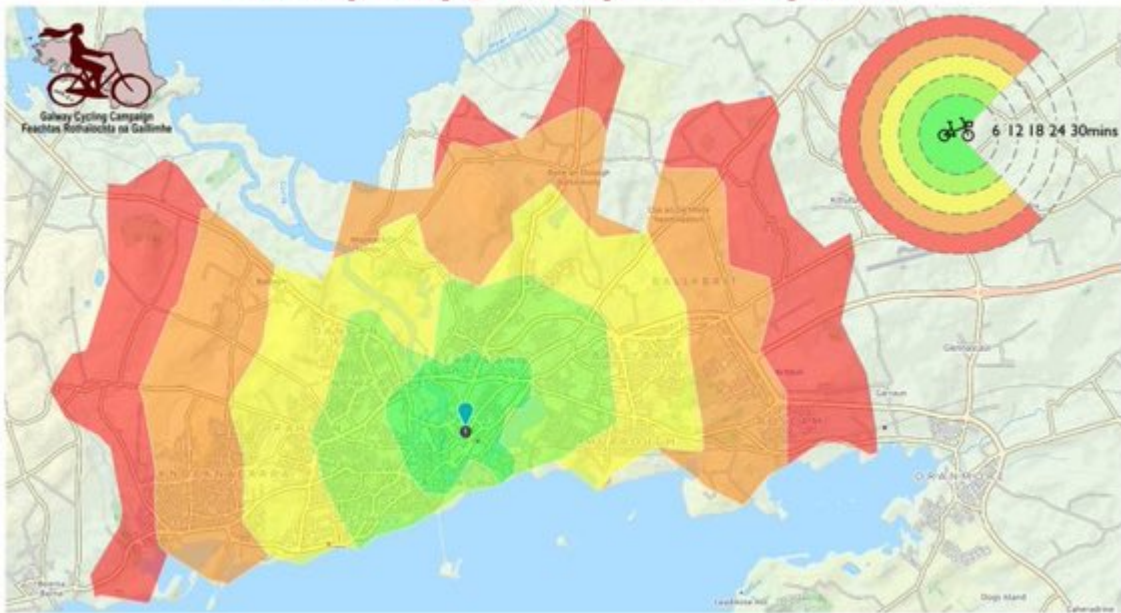
Galway City Journey Times by Bike

Figure 14 - Galway city journey times by bike (Galway Cycling Campaign, 2020)

The research also rejects hypothesis 2 **(H2)**. It was found that one's zone of residence did influence their frequency of public transport use. This finding followed prior research which suggests that public transport provision is greatest and most effective close to the city core (Chevallier et al., 2018). However, those living closest to or in the centre tend to rely more heavily on active transport modes such as walking and biking (Glaeser et al., 2008).

Hypothesis 3 and 4 **(H3, H4)** did not achieve significant results and as a result could not be rejected by the research. This meant there was no evidence found to suggest that the provision of car parking at people's place of work/education had an enhancing or disenhancing effect on these relationships. However, it is of great importance to note that the availability of car parking at one's place of work/education did indeed have a significant influence on a person's car dependency levels, as the analysis rejected hypothesis 9 **(H9)**. While, to the best of the author's knowledge, there is no prior research on the hypothesis in question **(H3)**, the latter point is consistently analysed in research. Many of which have also declared that an increase in car parking contributes to an increase in car use/dependency (Stradling, 2003, Hunter et al., 2021, Yin et al., 2018, Guo, 2013). The idea of a generous parking supply provoking a car dependent culture in Galway was reflected in both

the quantitative and qualitative findings **(H9)**. Therefore this research recommends a reduction of parking in the city centre and places of education/employment.

A previous study suggests that car dependency tends to decrease once more viable transport options become available (Zhang, 2006). However, through hypothesis 5 **(H5)** it was not proven that a lack of alternatives to car travel would have an effect on the relationship between the zones further from the city and car dependency. The interaction term made no difference to the effect of the aforementioned relationship and therefore **H5** failed to be rejected. This provokes interest as the respondents did not indicate that their car use habits were not enhanced where there was a lack of alternatives for them to take. This might suggest that car use is a preferred means of transport regardless of what alternatives might be available to them. This sentiment was reiterated by Colette Connolly who believes Galwegians are generally uninterested by other modes of transport.

Hypothesis 6 (H6) also failed to be rejected. It failed to prove that a lack of alternatives to car travel would have an enhancing or disenhancing effect on the relationship between zone of residence and frequency of public transport use. Once more this contradicted the previous research of Zhang (2006).

The analysis for hypothesis 7 **(H7)** achieved significant results and therefore could be rejected by this research. This means that an increase in use of public transport meant a likely reduction in car dependent behaviour. This is a well documented trend which fails to cause much surprise (Gardner and Abraham, 2007, Paijmans and Pojani, 2021).

Finally, hypothesis 8 **(H8)** was also rejected in this research, concluding that an increased awareness in environmental issues could indeed have an effect on the relationship between zone and car dependency and therefore lead to one taking climate action such as reducing one's car use. This concurred with the findings of Timmons et al., 2022, Leiserowitz et al., 2021). However, in the expert interview, Connolly did show some reservations about this finding. Her main concern being that the general public did not have a high awareness of transport emissions. She predicted that a mass shift in culture would be extremely arduous. However, this

research does suggest tackling this challenge through educational campaigns. This point is elaborated on in section 5.3.

PROCESS model 10

As seen in *Table 2*, the results of the PROCESS model did not totally align with the individual results discussed above. This may be attributed to the very complex nature of this model, especially in a behavioural science setting as is the case in this thesis. Car dependency does not follow a simple utility or cultural framework, making it harder to predict. The interactions are not simply additive and are therefore much more varied.

The PROCESS model found the public transport variable to be the only significant outcome. Interestingly, this suggests that one's use of public transport can explain whether people are car dependent or not. While the zone variable did achieve significant results in the regressions its effects disappeared when tested concurrently with public transport usage. The PROCESS model signals that if one does not use public transport frequently then the likelihood of them being car dependent increases, regardless of other variables.

Policy wise this is interesting as it shows that unless one can and is willing to rely on a quality public transport service, then they will likely be dependent on their car to travel. It highlights concern for the viability of other modes such as walking and cycling. For a small city, where the furthest studied zone was under 5km away from the centre, one might expect that active transport would be an effective tool to coax people from their cars. However, as the quantitative and qualitative data demonstrated, road hostility/lack of infrastructure has so far prevented a mass transition towards walking and cycling.

The figure below demonstrates the relationships and interactions that were found to be significant in both the regression and PROCESS model analysis. Green arrows indicate significance in both analyses, red indicates significance in the regressions only and black shows insignificance in both.
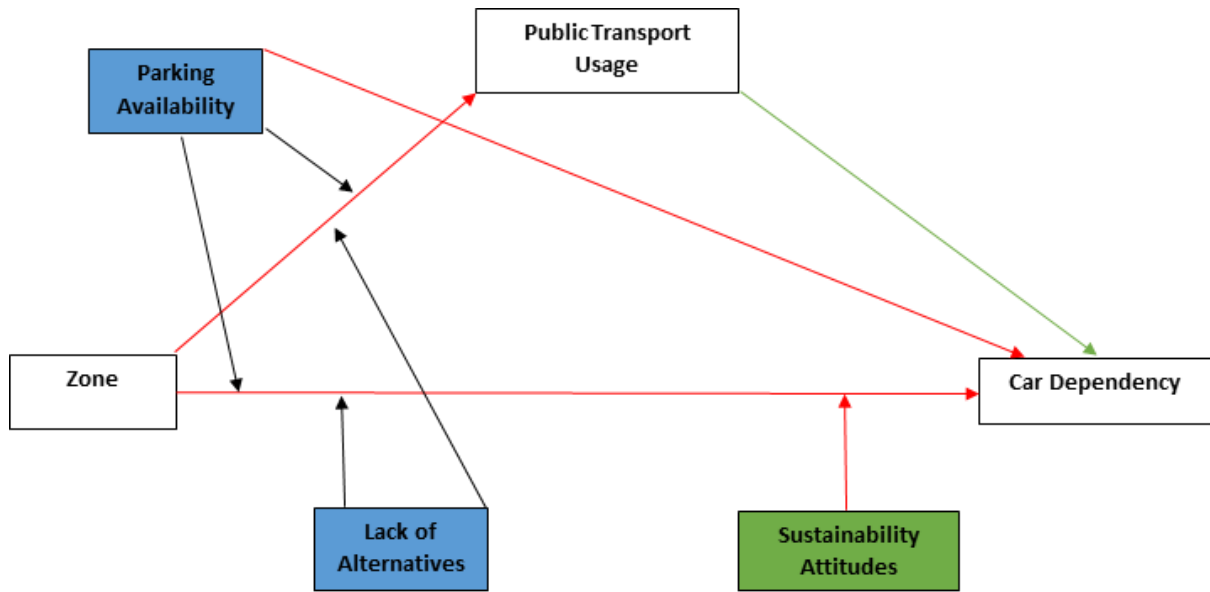
Figure 15: Conceptual model with regression and PROCESS model results displayed

5.3 - Discussion (quantitative and qualitative) and recommendations

This section aims to focus on the main talking points of this research: parking availability, distance/density, availability of alternatives (public and active transport) and sustainability/culture. Both the results of the quantitative and qualitative research were drawn upon to discuss and make recommendations for each of these areas of concern.

This thesis set out to gain an understanding of what factors enable and/or provoke a car dependent society to develop in Galway city. The research found a clear societal reliance on the private car in both the quantitative survey (59.5% of people using a car to access the city) as well as in the qualitative analysis ("The whole city is based on car parks and the private vehicle to move around"). The conceptual model was inspired by the *Cycle of automobile dependency* model by Litman (2014). It adopted some of the influencing factors discussed in that study in order to test their effects on car dependency in Galway. This discussion section aims to touch on each of the sub-questions of this thesis in order to answer the main research question.

Distance/Density

The idea of distance being an influencing factor in someone's decision to travel by car is not surprising, having been cited as a reason to abstain from other modes in prior research (Gardner and Abraham, 2007, Paijmans and Pojani, 2021) as well as this one. However, the fact that those living further from Galway city are significantly more car dependent than those living closer does spark an interesting discussion point.

Galway is a low rise city with many dwellings including no more than 2 stories, many of which are detached buildings. The question of increasing densification in the city in order to curb car dependency was therefore raised with Colette Connolly in the expert interview. While she demonstrated that she was no great fan of encouraging high rise densification in Galway, she did find such developments to be acceptable when built under the right conditions. She insisted that city centre developments should be built without car parking and only where public transport exists/will exist.

High-rise developments are not extremely common in Galway or in Ireland in general. However, densification could be achieved by other means. The current Minister for housing, Darragh O'Brien T.D., has highlighted "above shop" vacancies in every village, town and city in Ireland, including Galway. It is thought that by refurbishing such units for residential purposes a more vibrant and liveable city will be created (Finn, 2021). Furthermore, it would help to alleviate the gargantuan housing crisis which the city of Galway is facing (Hearne, 2020). Such units would be proximite/accessible to both the centre and places of work/education, meaning people could possibly reduce their commuting distance and therefore be less likely to be car dependent.

Parking

The quantitative analysis of this research found that car parking availability increased people's tendencies to be dependent on their car. In the expert interview with Colette Connolly, the councillor unreservedly agreed with the sentiment of the research, that by providing car parking at a given location it would motivate one to drive there. As was stated in previous research, Galway has the highest provision of car parking per capita out of all cities in Ireland (Rogers et al., 2013). The results of

both research methods of this thesis would indicate that the Galway City Council's policy of providing a large selection of car parking is promoting car use and car dependency in the city.

This finding begs the question as to where parking should be reduced and or removed. This question went beyond the scope of the quantitative analysis, however, the views in the expert interview might provide some insight into what could be done regarding car parking. Connolly called for better monitoring of car parking around the city. She claimed that many people simply illegally park near schools, shops and service providers such as banks and post offices. While she did believe there was an excessive amount of car parking provided in the city, Connolly declared that many people will choose to take their car "to the door" of their destination even when parking is not provided as they did not fear any repercussions. This, Connolly explained, is reinforced by a culture of "no respect" for rules which she connected with Ireland's colonial past. She said this results in a blatant disregard for rules which cannot be defended.

The expert interview also highlighted the issue of minimum parking requirements for residential developments. Connolly said that by ensuring parking was provided to residents, regardless of their proximity to the centre, would result in many of these residents opting to drive. The convenience of driving would have to be minimised by decreasing parking provision, according to Connolly. This is a feasible policy to implement, providing that the political will can be mustered.

Car parking in the centre is widely available. According to the council website there are 3,284 spaces in private car parks alone (Galway City Council, 2022). The council also provides their own parking at multiple locations including 510 spaces on the Dyke Road as well as over 2,000 on-street parking spaces (as of 2013) (Bradley, 2013). Such ample provision of parking attracts thousands of people to drive to the small city centre. The council even advertises car parking availability on display screens on roads entering the city. In order to combat congestion and the associated peril imposed on the planet, the council might ought to revisit such car convenient policies. Instead restructuring the spatial share of the roads in favour of active and public transport.

While car parking availability at one's place of work/education was the focus of the quantitative research, Colette Connolly, in the qualitative study, was adamant that parking at people's residence plays a significant role in promoting car use. This belief is supported by other studies (Yin et al., 2018, Guo, 2013). At multiple locations in the city there are residential roads which have street parking available in front of the residences as well as to the rear of each property. Many residents opt to use the on-street parking instead of using their own private spaces. As a result there is no space for bike/bus lanes or adequate footpaths. This paper therefore recommends that such on-street parking be reviewed in order to tackle car dependency. Examples of such roads can be found from residences 55-87 Lower Salthill Road as well as Saint Mary's Terrace on Taylor's Hill Road.

Image 3: Cars parked in front of Saint Mary's Terrace, despite car parking being available to the rear of the properties.

Alternatives

The quantitative analysis showed that the availability of alternative modes of transport did not not influence the relationships between zone and car dependency or zone and frequency of public transport. This mirrors comments expressed by Councillor Connolly who experienced constituents protesting improvements to active and public transport, a prime example being the Salthill cycleway. From results garnered by this research it seems that many Galwegians are not hugely interested in swapping the convenience of car travel for more sustainable modes. The issue therefore looks to lie with the attitudes people hold towards a sustainable transport model and the current state of affairs regarding car dependency.

Sustainable awareness and culture

The findings of the quantitative and qualitative research were somewhat contradictory insofar as the survey suggested that those who showed an awareness of sustainability issues were less likely to be car dependent. Meanwhile, Colette Connolly showed a great deal of pessimism in people linking their car use and its effects on the planet and local environment. While Connolly did not refute the findings of the survey, she felt that these attitudes were not widespread enough across the city in order to spur notable change. From these findings it might be suggested that an awareness of environmental issues and possibly the social issues too, could be a key tool in mitigating car use/dependency in Galway city.

The initial aim of the research was to identify whether car dependency in Galway is enabled primarily by utility issues such as the provision of parking and alternative modes or by an attitude issue which focused on sustainability. While parking was found to be a significant predictor of car dependence. The idea of attitudes towards transport modes powerfully impacting the viability of a sustainable transport model being developed cannot be ignored. This finding clearly demonstrates urban planning's position as a social science.

The expert interview played an "illustrative" role, allowing the research to put "meat on the bones of dry quantitative findings" (Bryman, 2014). Councillor Connolly was able to describe the political climate of the city and how she has experienced people

expressing interest in moving away from car use in principle but not in practice. This qualitative element shone some light on the reality of provoking change in Galway.

Summary

To conclude, the city of Galway showed many clear signs of a car dependent society. While there seems to be a link between those who are aware of sustainability issues and making lifestyle changes (e.g. reducing car use) to combat such issues, it remains clear that physical interventions would also be required to spur a paradigm shift away from car dependency might be achieved in Galway. With the data gathered from this research, a reduction of car parking, well planned densification and an education campaign about the effects of car use on the environment should be employed in order to make this shift.

5.4 - Limitations

This paper encountered an array of factors which limited the scope of the research. In fact, similarly to Smit (2019) the paper struggled to strike a balance between retaining a fine focus on the exact issues at hand given the broadness of the topic of car dependency.

The research aimed to decipher whether car dependency in Galway can be attributed to the physical built environment or personal attitudes/culture. However, the makeup of this study did not necessarily pit these elements against one another to see which one contributed most to car dependence. Instead each element was tested individually but a hierarchy of impactfulness was not established. It was decided that uncovering a hierarchy objectively would have been overly difficult given the limits of time, expertise and resources. While it was thought that measuring it subjectively by asking respondents to rank their influence on their car use would not have provided notable and trustworthy data.

A critical limitation of this study was the fact that much of the data collected was self reported. This meant that aspects such as being car dependent or having high sustainable consciousness was rated subjectively by each individual. This made

generalisability somewhat problematic and inevitably led to a certain level of distortion in the results. However, ascertaining a highly accurate and objective representation of such a large sample would have been overly arduous. The same goes for other elements such as gaining accurate data on people's public transport usage and car parking availability.

The creation of zones was based on distances to the city. Participants were asked which area they lived in from a list of options, however borders between these areas are very fluid which would have meant that not all respondents were allocated to the right zone, in line with the research. Furthermore, distances to the city did not take the road network into account. Instead "as the crow flies" measurements were employed. This limited the research's ability to investigate the effect distance from the city centre has on car dependence. Similarly, alternative transport options were measured based on how they were perceived by the respondent. So decent public transport may have indeed been on offer to certain individuals but it may not have been on their radar or simply they did not see any alternative as viable for their lifestyle.

The research did not ascertain the location of respondents' place of work/education. While availability of parking at this location was found to influence the likelihood of one being car dependent, the distance one travelled to work was not taken into account and therefore the research could not solely attribute car use to parking availability.

The study fails to capture the views and habits of people over time. Measuring such elements before and after a change e.g. the opening of a bus route would have added to the research.

While a wider selection of expert interviewees would have been desirable to capture a broader understanding of the political landscape surrounding car culture, this was not possible due to time constraints as well as the issue of securing interview candidates. Councillor Colette Connolly was perfectly qualified to comment on the issues of this research given her recent stint as Mayor of Galway, dealing with many

of the topics that this paper discussed. However, it would have been interesting to hear from experts/politicians who held contrasting views to Connolly.

Bias in the online survey was also difficult to avoid. This is due to the fact that the topic of the survey tended to attract a certain type of person. For example, multiple cycling advocacy groups shared the survey with their followers which may have skewed certain results such as the number of cyclists.

5.5 - Future research

Due to the limitations, as expressed above, there are various avenues relating to the subject of this research which remain unexplored. Many of which would provide great insight into the topic of car dependency. There appears to be a plethora of research that could be done on the subject of attitudes towards sustainable transport and willingness to reduce car use in Ireland, with a possible comparison to other countries. It might also be interesting to research how people react to the implementation of car restrictive measures or pro active/public transport measures such as bike lanes.

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Appendices

Appendix 1

Expert Interview Guide

Section 1

How do you generally travel around Galway city?
Why do you choose this mode?

1) If car: What stops you from taking PT or AT?
2) If PT or AT: why not a car?

Section 2

Current model

How do you view the overall transportation system,
including car infrastructure,
with regards to effectiveness, congestion and sustainability?

As was found in my online survey, Almost 60% of adults use a car in order to access Galway city centre and their place of work/education.
Firstly, do you see this as an issue and secondly, why do you think this is the case? (is it due to the utility issue of there being a lack of infrastructure, car centric roads or is it due to the culture that exists?)

In your opinion, is Galway a car dependent city?

State of Public Transport / Availability of Alternatives

How would you describe the public transport network in Galway city? Is it fit for purpose?

The survey also found that over a third of people indicated that they never use public transport while only 18% said they use it at least once a week.
Why do you think this is the case?

How can ridership be increased?
What are the council's plans to help achieve this?

Active Transport

The survey found that 11% of people biked to the city while 18% walked. How do you think this can be increased?

 The survey found that hostile roads and a lack of infrastructure were the main barrier to people walking and cycling in Galway. Is the council trying to correct this and how do you plan to do it?

The Salthill cycleway was cancelled earlier this year.
Why do you think the vote failed and do you see the project making a comeback in the future?

Parking

How would you describe the car parking situation in Galway city?
Regarding accessibility, availability and cost

My research found that the availability of parking at one's place of work/education was a significant predictor of car dependency in Galway. While a different study found that Galway had the second highest allocation of car parking spaces per capita in the country after County Monaghan. What is your reaction to these findings?
Do you think car parking provision needs to increase, decrease or stay the same?

Galway city council provides multiple free parking spots, perhaps most notably on the Salthill prom. Do you support this policy?

Sustainability attitudes

Do you think that Galwegians take environmental issues into account when choosing their mode of transport?

Should awareness of the environmental costs be increased? How might this be done?

The air quality recorded in Eyre Square regularly exceeds the official W.H.O. recommended levels for safe living.

How do you think this can be tackled?

Zone/Density

Findings from the research found that those living further from the centre are more car dependent to those living closer. Galway is currently a low rise city. Do you see a future of a more dense Galway?

The city ring road has been granted planning permission by An Bord Pleanala. This is despite the Bord recognising that such a road would not reduce traffic or pollution in the Galway area.
Should the plan proceed?
Why/Why not?

The Welsh government has decided that they will not build any new roads for motor cars in order to tackle climate change. What is your response to this decision and do you think this is something that could work for Galway?

How would you describe the political appetite for change towards a sustainable transport model?
What needs to happen for this to change?

Appendix 2

Copy of Online Survey

Intro
Scroll to bottom to continue

Thank you for taking part in this survey.

My name is Tom Concannon. I am a masters student in the Faculty of Spatial Science at the R.U.G.. This survey forms part of a thesis which looks to investigate the attitudes and realities of car use in Galway, Ireland.

The survey will be completely anonymous and all data collected will be used strictly for the purposes of this research. Your participation in this survey is completely voluntary and you may choose to leave the survey at any point.

Finally we ask you to please read all questions clearly and not leave this browser until after completing this short survey.

By our estimation the survey takes about 5 minutes to complete.

If you have any queries about the survey or the research itself, please contact me by email: t.concannon@student.rug.nl

Q1 Gender

○ Male (1)

○ Female (2)

○ Non-binary / third gender (3)

○ Transgender (4)

○ Other (please specify)/Prefer not to say (5)

_____

Q2 Age

    ○   18-24 (1)

    ○   25-34 (2)

    ○   35-44 (3)

    ○   45-54 (4)

    ○   55-64 (5)

    ○   65-74 (6)

    ○   75 + (7)

Q3
Where in Galway do you live?

▼ City Centre (1) ... Galway County/other (16)

Q4 What mode of transport do you primarily use to to access Galway city centre?

    ○   Private car (driver) (1)

    ○   Private car (passenger) (2)

    ○   Bus (3)

○   Train (4)

○   Bicycle (5)

○   Walk (6)

○   Motorcycle (7)

○   Scooter (10)

○   Taxi (8)

○   I never travel to Galway city centre (11)

○   Other (please specify) (9)

_____

Skip To: Q6 If What mode of transport do you primarily use to to access Galway city centre? = Private car (driver)

Skip To: Q6 If What mode of transport do you primarily use to to access Galway city centre? = Private car (passenger)

Display This Question:

    If What mode of transport do you primarily use to to access Galway city centre? != Private car (driver)

    Or What mode of transport do you primarily use to to access Galway city centre? != Private car (passenger)

Q5 If you do not use a car in order to access Galway city centre. Why not? (multiple answers are allowed but not required)

☐   No car available to me for this purpose (1)

☐   Driving is less efficient for my journey e.g. traffic, parking etc. (2)

☐   Public transport is satisfactory (3)

☐   I prefer to walk/cycle (4)

☐   Environmental reasons (5)

☐   Cost saving reasons (6)

☐   Other (please specify) (8)

_____

☐   I DO commute by car (7)

Q6 Please indicate by clicking on the bar chart, to what degree you agree with the following statements. 0 = strongly disagree while 10 = strongly agree.

	0 1 2 3 4 5 6 7 8 9 10
My lifestyle is dependent on using a car (1)	
I don't think about how I travel. I just get in my car and go. (2)	
I would like to reduce my car use, but there are no practical alternatives. (3)	
I am actively trying to use my car less. (4)	
I am interested in reducing my car use. (5)	
Galway offers excellent public transport options (6)	
Walking and cycling are viable alternatives to driving in Galway (7)	

I think about the environmental impacts when choosing my mode of transport (8)	

Q7 How often do you use public transport in Galway?

- ○ At least 5 times a week (3)

- ○ 3-4 times a week (2)

- ○ 1-2 times a week (1)

- ○ Less than weekly but more than once a month (4)

- ○ Less than monthly (5)

- ○ Never (6)

Q8 What do you see as the main barriers (if any) to using public transport in Galway? (Multiple Answers Accepted)

- ☐ Routes do not exist to serve me (1)

- ☐ Expensive fare prices (2)

- ☐ Routes are not direct enough (3)

- ☐ Routes are not frequent/reliable enough (4)

☐ Timetables are unclear/inaccessable (5)

☐ Using a car is easier (6)

☐ Walking/cycling is easier (7)

☐ Weather conditions e.g. walk to bus stop (8)

☐ Public transport is dirty/unpleasant (9)

☐ I would never think to use public transport (10)

☐ No barriers (11)

☐ Other (please specify) (12)

_____

Q9 What do you see as the main barriers for you to walk or cycle in Galway (if any)?
(Multiple Answers Accepted)

☐ Hostile roads/Lack of infrastructure (1)

☐ Weather (2)

☐ Distance is too long (3)

☐ Physically difficult (4)

☐ Area is too hilly (5)

☐ Feeling unsafe around others (anti-social behaviour) (6)

☐ Hygiene reasons/sweating (7)

☐ I am not the type of person who walks or cycles (8)

☐ No barriers (9)

☐ Other (please specify) (10)

_____

Q10 What mode do you primarily use to commute to your place of work/education?

○ Private car (driver) (1)

○ Private car (passenger) (2)

○ Public transport (3)

○ Walk (4)

○ Cycle (5)

○ Scooter (6)

○ Taxi (7)

○ Motorcycle (9)

○ Other (please specify) (8)

_____

Page Break

Display This Question:

If What mode do you primarily use to commute to your place of work/education? != Private car (driver)

Or What mode do you primarily use to commute to your place of work/education? != Private car (passenger)

Q13 How does the provision of parking affect your choice not to drive to your work/school?

○ I do not commute by car due to lack of parking availability (1)

○ I do not commute by car due to parking costs (2)

○ Both of the above (7)

○ My choice not to drive is a practical decision (3)

○ I would drive if I had a car and/or a license (4)

○ Parking plays no role in my transport choice (5)

○ I DO drive to my work/school (8)

○ Other (please specify) (6)

_____

Q12 Regardless of whether you drive or not, how would you describe the car parking situation at your home and your place of work/education?

	Parking is FREE and is consistently available for me (and my household/colleagues) (1)	Parking is FREE but my space is not guaranteed (2)	Parking is PAID and consistently available for me (and my household/colleagues) (3)	Parking is PAID but I do not have a space guaranteed to me (4)	No car parking available nearby (5)
My home (1)	○	○	○	○	○
My work/education (2)	○	○	○	○	○

Q14
How would you describe the traffic situation in Galway?

- ○ Very good (1)

- ○ Good/not a problem (2)

- ○ Ok (3)

- ○ Bad, lots of traffic (4)

- ○ Very bad, high levels of traffic (5)

- ○ No opinion (6)

Q15 Do you think that measures should be taken to reduce car use in Galway? Examples might include: restricted car access at certain locations, congestion charges, removing car space for more walking and cycling infrastructure etc.

○ Definitely not (1)

○ Maybe some measures (2)

○ Probably yes (3)

○ Definitely yes (4)

○ No opinion (5)

Q16 What mode of transport would you most likely use if you were looking to reach the following locations in Galway city?

	Private Car (1)	Public Transport (2)	Walk (3)	Bicycle (4)	Motorcycle (5)	Scooter (6)	Taxi (7)	Other (10)	I never travel to this location (8)	I do not know this location (9)
(A) Blackrock Diving Tower, Salthill Promenade (1)	○	○	○	○	○	○	○	○	○	○

(B) Shop Street, Galway city centre (6)	○	○	○	○	○	○	○	○	○	○
(C) Woodquay, Galway city centre (2)	○	○	○	○	○	○	○	○	○	○
(D) Pearse Stadium, Salthill (3)	○	○	○	○	○	○	○	○	○	○
(E) Galway Shopping Centre (Headford Road) (4)	○	○	○	○	○	○	○	○	○	○
(F) Your local supermarket (5)	○	○	○	○	○	○	○	○	○	○

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