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Corresponding Author: Prof. Brian Caulfield, Ph.D

Corresponding Author's Institution: Trinity College Dublin

First Author: Gerard Deenihan

Order of Authors: Gerard Deenihan; Brian Caulfield, Ph.D

Abstract: This paper seeks to examine how tourists value different types of cycling infrastructure using the results from intercept stated preference survey that was carried out amongst tourists in Dublin. The attributes used in the stated preference scenarios were: time, facility type, weather, and route gradient. A nested logit model was created to analyse the data.

It was found that a tourist is willing to increase their cycling time by approximately 100% in order to cycle upon a fully segregated from traffic cycling facility rather than along a road without cycling infrastructure, and are willing to increase their time by 40-50% to be able to cycle along a road with a cycle lane rather than a road without cycling facilities. Younger, male tourists, who own one or more bikes are more likely to choose a road without cycling facilities, while older, female tourists, who do not own any bikes, are more likely to choose a road with cycle lanes or a segregated from traffic cycling facility.

Presently, research into cycling and tourism has not been overly developed. In recent years, there has been an increased focus on research into this area. The research that presently exists is aligned more towards large scale events such as the Tour de France, and adventure tourism in general. This paper casts a light onto the area of cycling for tourist purposes and develops a value based system that can be used in the planning of cycling infrastructure in tourist locations and rural areas.

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Do tourists value different levels of cycling infrastructure?

Gerard Deenihan, Brian Caulfield[1]
Department of Civil, Structural and Environmental Engineering, Trinity College Dublin, Dublin 2, Ireland

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[1] Corresponding author: Email: brian.caulfield@tcd.ie Phone: +353 1 896 2534

*Highlights

Research Highlights

- The findings show the value tourist place on inter-urban cycleways
- The results can be used by practitioners to conduct cost benefit analysis of new cycle infrastructure
- The findings show tourists are willing to pay for segregated cycleways

Do tourists value different levels of cycling infrastructure?

Abstract

This paper seeks to examine how tourists value different types of cycling infrastructure using the results from intercept stated preference survey that was carried out amongst tourists in Dublin. The attributes used in the stated preference scenarios were: time, facility type, weather, and route gradient. A nested logit model was created to analyse the data.

It was found that a tourist is willing to increase their cycling time by approximately 100% in order to cycle upon a fully segregated from traffic cycling facility rather than along a road without cycling infrastructure, and are willing to increase their time by 40-50% to be able to cycle along a road with a cycle lane rather than a road without cycling facilities. Younger, male tourists, who own one or more bikes are more likely to choose a road without cycling facilities, while older, female tourists, who do not own any bikes, are more likely to choose a road with cycle lanes or a segregated from traffic cycling facility.

Presently, research into cycling and tourism has not been overly developed. In recent years, there has been an increased focus on research into this area. The research that presently exists is aligned more towards large scale events such as the Tour de France, and adventure tourism in general. This paper casts a light onto the area of cycling for tourist purposes and develops a value based system that can be used in the planning of cycling infrastructure in tourist locations and rural areas.

1. Introduction

Presently cycling in Ireland is undergoing a renaissance. Between 2006 and 2011, cycling in Ireland's capital, Dublin has increased by 45% (Dublin City Council, 2012; Caulfield, 2014). This large scale increase has been replicated nationwide with an increase in cycling of 15% (Central Statistics Office, 2012). This has led to an increased focus on cycling for commuting, leisure and tourist purposes at both local and national levels. In the past, the area of cycle tourism in Ireland received very little attention, however, in recent times the importance of this sector of the tourism market has become apparent. In 2009, it was estimated that cycling tourists spent €97 million while in Ireland (Fáilte Ireland, 2009). The majority of the cyclists that were surveyed were just satisfied with cycling in Ireland, however; 12% of those surveyed were either dissatisfied or very dissatisfied.

In 2009, Ireland's first National Cycling Policy Framework was adopted. The specific objectives were to promote the development of walking and cycling in Ireland. One objective was to "*Provide designated rural signed cycle networks providing especially for visitors and recreational cycling*" (Smarter Travel Office, 2009). From this Framework, the National Cycle Network Scoping study was created (National Roads Authority, Ireland (2010)). The document outlined some 2,000 kilometres of corridors along which high quality cycling facilities were to be constructed. One such project is the Great Western Greenway in the north west of Ireland. The first phase of this project, an 18 km route from Newport to

Mulranny was opened in April 2010. This phase was a “huge success” (Fáilte Ireland, Smarter Travel Office 2010) and a €3.5 million package was agreed to expand the route to 42 km. The 42 km route is currently the longest off-road cycling and walking trail in the Republic of Ireland. Deenihan et al (2013) estimated that this section of cycleway has a payback period of six years. The success of this infrastructural facility has led to many other potential facilities being considered for construction. Most of these proposals are along disused railway lines and canal towpaths.

With investments in infrastructure like the National Cycle Network it is hoped to increase the percentage of cycle tourists that are satisfied with cycling in Ireland and in turn increase the tourism numbers visiting the country. This should lead to an increase in expenditure from this category of tourism and also increase sustainable travel patterns within the areas. Lamont (2009) claims there has been a relationship between cycling and tourism since the 1890s, but it is only in recent years that these areas are being researched academically. It is important that research be carried out in these areas, as a lack of knowledge leads to misleading conclusions when categories of tourists are not defined properly. This can cause falsification, exaggeration, and an understatement of facts when it comes to the analysis of certain cycling groups. Burkart and Medlik (1981) also state why it’s important that research into tourism be carried out. It is necessary for three specific reasons. These are as follows:

- To evaluate the value and significance of tourism to a particular area
- To use in the design and planning of infrastructure and service for tourists
- To plan and create effective marketing campaigns

The Irish National Cycle Network, identifies the corridors along which cycling infrastructure should proceed. In many cases, there are several options along which these routes could be constructed. There is an extensive disused rail network in Ireland, along with many disused canals and their towpaths. In the past decade there has also been a relatively large extensive motorway construction programme which has led to many previously wide national roads with hard shoulders reverting to local and regional use. In order for the correct routes to be selected, it is crucial that the attitudes and perceptions of the potential users of these facilities be fully understood. One significant user group are tourists. The research presented in this paper examines the preferences of tourists for different standards of cycling infrastructure. The results were retrieved from analysis on a stated preference intercept survey carried out among tourists in the summer of 2012. One section of the intercept survey presented the tourists with various scenarios. In these scenarios the respondent was presented with different standards of cycling infrastructure that contained individual conditions for each piece of infrastructure. The respondent then selected their preferred option. Analysis was performed on these choices and is presented later in this text. The respondents’ demographic information was also noted in the survey. It was also analysed whether people’s choices and preferences alter between demographic categories.

2. Literature Review

Several studies have looked at methods to increase cycling. Stinson and Bhat (2004) determined that the most important factors affecting cycle commuting by means of an internet based survey. The results indicate that the most effective policy to increase cycling was to increase cycle parking at employment facilities. Cyclist training and education would also be an easy method of increasing cycling. Birk and Geller (2005) investigated the increase in cycling in Portland, Oregon over a thirteen-year period during which there were extensive improvements to cycling infrastructure. The paper shows that there was a 210% increase in cycling over the time period and a clear correlation between improvements in the cycle network and increases in the usage of the facilities.

A number of international case studies have been published on the benefits of greenways. Richardson (2006) examined the results of intercept surveys on Switzerland's national cycle network over a three-year period. The surveys gathered information at 16 random locations around the network. Temperature, rainfall and cyclist numbers were noted over a period of time at these locations and for certain times of the year, every year, for three years. Intercept surveys were carried out on a passing cyclist every time a certain number of cyclists passed. This information allowed for specific types of cycle flows (purpose/leisure/tourist) and weather patterns to be correlated. The intercept surveys allowed the trip types, distances travelled and the contribution to the local economies to be determined. This paper concluded that there are about 7.2 million day trips on the network and 350,000 overnight trips annually on the network. Other benefits of investing in cycling infrastructure are the improvement in the international and national image of a location.

Stinson and Bhat (2003) determined the variables, which affect a cyclist's route choice from an analysis of commuter cyclists using a stated preference survey. The paper concluded that the six most important factors in order of importance were: lower travels times, road classification, types of cycle infrastructure, barriers between motorists and cyclists, pavement quality, and fewer intersections. These qualities varied from commuter to commuter. The main causes of the variances were a commuter's age, and residential location. Morris (2004) showed that there is an increase in the percentage of residents cycling for a "transportation trip" who live within half a mile of an urban cycle trail. This paper outlined factors influencing cycle commute rates on trails. This paper differed to Stinson and Bhat's (2003) analysis and identified many other externalities such as competing facilities, numbers using a facility, land use around the facility and number of access points on/for the facility. These variables vary for different categories of users. In order to understand the variable for tourist related cycling, it was important to see how these trips are influenced. Downward et al (2009) wanted to determine the economic impact of sports tourism by looking at the economic impact of a cycle network in North East England. It was found that for leisure and tourist related cycling, expenditure and duration of trip had the largest affect on trip length. Duration did not directly affect expenditure and different route characteristics for this category of cyclists. Income and, if the users were in a group, group size, were key determinants in sports tourism expenditure. It was found that when planning infrastructure that targets tourists and leisure users, it is important to ensure that the infrastructure can cater for longer trips.

Caulfield et at (2012) looked at infrastructure preferences for cyclists in Dublin. This was done by presenting respondents with scenarios in a stated preference survey. The survey was designed using a fractional factorial design. The survey had 1,941 valid responses. The scenarios within this survey contained attributes of travel time, cycle route type, cycle route traffic, number of junctions, and adjacent vehicular traffic speed. It was found that a shared "cycle lane/bus lane" and a "no lane" options were very unlikely to be chosen by respondents. It was found that "off road cycle lane" option followed by a "greenway" option were both highly valued by respondents. Respondents who walked and cycled to work had the greatest value of time for journeys to and from work and those that drove or took public transport to and from work had a poor perception of cycling.

Presently, research into cycling and tourism has not been overly developed. Research in the areas of sports and cycling tourism has mainly focused on hallmark events where people travelling for sports tourism are spectators. These landmark events mainly consist of sporting tournaments that range in size from small scale (local sports teams competing), medium scale, and (national sporting leagues in a country); to large scale (Olympics, World Championships). Hinch and Higham (2011) demonstrate that sports tourism is composed of three main areas. These are as follows:

- Hallmark events
- Health and Fitness
- Outdoor recreation

Landmark events are extensively analysed in this text. Hinch and Higham state that outdoor recreation is, "an area that is inextricably linked to sport tourism" and that "One of the most dynamic components of outdoor recreation is adventure tourism". Ritchie (1998) found that globally, cycling for leisure, recreation and tourism has been re-emerging since the 1990s and that the relevant cycling industries' interest in the area at the time was scarce. It was found that there was not any demand related literature in relation to cycle tourism. In order for this area of tourism to grow appropriately and contribute to the economic and social well being of a rural area, the demand and supply side of cycle tourism needs to be further researched and fully understood. Lamont (2009) examines literature, both at an academic level and a government level, from around the world that analyses cycling tourism. It was found that defining cycling as a "strictly recreational phenomenon may be overly restrictive". This paper defines tourist cycling as:

- Persons who travel away from their home region, of which active or passive participation in cycling is the main purpose for that trip.
- Persons who travel for the purposes of engaging in competitive cycling, and those who travel to observe cycling events.

In 1999, Sustrans published a report on cycling tourism in the United Kingdom. Sustrans is a UK charity that endeavours to make sustainable travel by foot, bicycle and public transport more attractive. Sustrans (1999) found that cycle tourism was worth £695 million to the UK economy annually. This report found that it was important to develop cycle tourism as:

- Cycle tourism is positive at generating local trade and offers business opportunities, particularly in rural areas
- It is an environmentally sustainable form of tourism with minimal impact on the environment and can help reduce traffic congestion
- It utilises existing facilities and often under-used facilities such as quiet laneways, and canal towpaths,
- It can provide a use for disused railway lines.

This Sustrans report also conducted several case studies into cycling infrastructure that catered predominantly for tourists. One such case study was the “C2C Cycle Route” in Northern England. The investigation found that the average daily spend of a user was £30, and that 76% of the expenditure was in local businesses such as pubs, restaurants, cafes and accommodation. In 1997, the expenditure by C2C users was £1.1 million. In order to grow this market, the report established that it was necessary to create:

- Safe, convenient, and attractive cycle routes that cater for both long and short distance cycling
- Safer and easier access points into and out of cities and towns
- Cycle routes that have as little interaction with vehicular traffic as possible so as to reduce the perceived danger from passing traffic

Hinch and Higham (2011) discuss how development of sport related leisure services is one successful approach that can be used to reimage a place. In order for sport tourism to develop at a destination, resources and infrastructure that cater for the targeted sport and tourism must exist. These resources and infrastructures need to be planned and provided in a balanced and coordinated way with the development goals of the location. Coordination is important as there can be a large overlap between resources for sport and those for tourism. Another project that is similar to the C2C is the Munda Biddi trail in Australia. The Munda Biddi trail is presently 1,000km long (Munda Biddi Foundation, 2012). The trail is in a predominantly rural location and passes through several small towns. It is constructed along forest tracks and disused railway lines. The trail enjoys 21,000 visitors annually; the majority stay for three days along the route. This leads to a demand for accommodation, cycle hire, food and transport in the towns located along the route. It is estimated that in 2013, the Munda Biddi Trail will bring AUD$13 million into the South West and Great Southern communities of Australia. Deenihan et al (2013) investigated the success of the Great Western Greenway in the north west of Ireland. The Greenway was constructed along a disused railway line with the main purpose of attracting tourists to the area. It was found that the project was very successful at attracting many more tourists than initially thought. The Greenway was found to have a payback period of six years. This project also led to increased sustainable travel amongst the local population with many people using the project to commute and for recreational purposes.

Hough and Hassanien (2010) produced a study into the internal purchase choice behaviour of Australian and Chinese tourists in Scotland. The survey they conducted had a response rate of 88. The survey was distributed directly at tourist destinations and also by tour operators. Becken and Gnoth (2004) looked at segmenting tourists into categories based on their travel behaviour. This paper analysed a dataset formed from a continuous international visitor survey conducted by Tourism New Zealand. The dataset used included 1,122 people. Kozak (2001) sought to compare the satisfaction levels of two nationalities at two different tourist destinations. The self-administered survey contained 1,872 responses. Zhang et al (2012) sought to analyse time and money use by tourists at different destinations. The questionnaire was designed to collect detailed touring activity information from tourists (e.g., tourist sites visited, departure/arrival time and money spent at each site, travel mode choice, and tourists’ subjective evaluations of major tourist sites) and individual attributes. In total, 6,585 questionnaires were randomly distributed to tourists at major attractions and tourist information offices during the four seasons of the year 2007. As a result, 761 respondents returned the questionnaires. Reilly et al (2010) performed intercept surveys on tourists in Whistler, British Columbia in order to collect information on their travel behaviour and to form a basic visitor profile. It was found that tourists who travelled furthest were most likely to change their transportation choice towards a more energy efficient mode. This paper looked at the shift towards more sustainable transport which in this instance was public transport. Cycling was not included in the sustainable transport considered by the tourists; however, the paper demonstrates willingness by tourists for more sustainable transport options. The intercept survey had 1,643 responses. In the intercept survey, email addresses of the respondents were collected, and a further 467 people completed a more detailed online survey. The research objectives were very similar to the objectives that the authors of this paper set at the start of this paper. Reilly et al (2010) used a fractional orthogonal factorial design in the formation of scenarios that were presented to the respondents in their survey.

3. Methodology

In order to examine tourist preferences for cycling infrastructure a stated preference survey was conducted. Discrete choice explains and allows choices to be predicted when presented with a series of alternatives. This usually translates into a range of scenarios presented to a respondent with several options. The respondent is then requested to pick one of the presented options. Louvierre et al (2000) provides a clear description of the theory that underlies discrete choice models. As mentioned in the literature review the fractional factorial design is a very effective way of designing scenarios for a survey. Louviere et al (2000) and Hensher et al (2005) develop the factorial design process very comprehensively.

3.1 Data collection

The intercept stated preference survey was undertaken in the summer of 2012. The intercepts occurred at two locations in Dublin City, Ireland. The first location was adjacent to the Trinity Walking Tours Kiosk in Trinity College Dublin. The second location was adjacent to an adventure tour company kiosk in a hostel in Dublin city centre. Dublin city was a very suitable location for these intercept surveys as the city contains six out of the ten most popular fee paying visitor attractions and nine out of the ten most popular free tourist attractions in Ireland. Trinity College is currently also in the top five tourist attractions in the country and the hostel was opposite another of the top tourist attractions in the country (Failte Ireland (2012)). These two locations allowed for a large representative sample of tourists to be retrieved from the intercept surveys. The survey was also translated into German, French and Spanish. In total there were 282 valid responses to the surveys, which were approximately 35 responses per version of the survey. There were another five surveys that were invalid where sections were either incomplete or skipped by the respondent. From the Central Statistics Office it is known that Ireland had 6.6 million visits by overseas residents (Central Statistics Office, 2013).

3.2 Defining the attributes and attribute levels

The initial "problem" that needed to be solved was whether tourists would be willing to sacrifice time, comfort and energy in order to travel upon perceived safer cycling infrastructure. There are models that have been used to evaluate similar questions for cycling for commuting purposes (Caulfield et al (2012), Stinson and Bhat (2004), Stinson and Bhat (2003)). However, to the best of the author's knowledge, no research has been conducted to model to access cycling for touristic and leisure purposes. From this point it was fundamental to determine the key attributes that could be used in the evaluation of this. These attributes were identified from studies completed around the world and were compiled into a list of the ten most relevant attributes (Stinson and Bhat (2003), Caulfield et al (2012), Morris (2004), Downward et al (2009)), which are as follows:

- Vehicle Parking
- Directness
- Comfort
- Weather
- Type of Facility
- Ancillary Facilities
- Time
- Cost
- Route Slope
- Route Length

This survey was also created with several areas of the country in mind where there are presently cycling facilities planned. It was crucial to identify the attributes that would be experienced most on these planned facilities. From reviewing similar studies (Stinson and Bhat (2003), Caulfield et al (2012), Morris (2004), Downward et al (2009)), and investigating the potential infrastructure, it was decided that the attributes to be included in the scenarios would be:

- Type of facility
- Time
- Weather
- Route Slope

Cost and route length were omitted from the scenarios as cost, time and route length would be highly correlated. This is because these attributes are intrinsically connected. For example, as the route length increases, so too would the time and cost. It was decided that time would be used as it can act as a proxy for both route length and cost. As the fundamental attributes that are to be included in the scenarios are identified, the attribute levels need to be decided.

The attribute levels were selected to reflect the times, and facility options that would be potentially encountered by the respondents in these areas. The attribute levels can be seen in Table 1.

INSERT TABLE 1

From Louvierre et al (2000), it is known that a full factorial design would not be practical in designing the scenarios section of the proposed survey. If a full factorial were to be used with the attributes and the attribute levels outlined in Stage 2, there would be in total 19,683 combinations. As one would expect, this would prove very unrealistic to get a respondent to the survey to complete all the combinations. Therefore, a fractional factorial design was used.

It was decided that main effects and two-way interactions should be included in the design of the survey. This was decided as it would reduce the number of scenarios to be evaluated in the factorial design. Hensher et al (2005) specify exactly how an orthogonal design is produced in the software package SPSS. This process was followed and produced an orthogonal design with 32 different combinations. A "blocking variable" was included in the formation of the orthogonal design. This was included in the design in order to reduce the choice sets each decision maker would be presented with. This allowed the different combinations of the scenarios to be placed into eight groups of four scenarios.

3.3 Survey layout

At this point, the basic skeleton for the scenarios has been formed. Each individual scenario could now be formed and organised into one of the eight blocks. Each block would represent one version of the survey and contain four scenarios. This ensured that the survey could be completed quickly and without inducing respondent fatigue. Having formed the scenarios, the focus could move onto developing the rest of the survey. The survey was split into three sections. They were as follows:

- Section 1 – General Questions
- Section 2 – Scenarios
- Section 3 – Personal Details

Section 1 and Section 3 would remain the same for all eight versions of the survey. Section 2, containing the scenarios, would alter between the combinations of the scenarios from stage 4, from survey to survey.

Section 1 consisted of questions that focused on aspects of the tourist's trip whilst they were in the country such as trip purpose and trip length. The tourist's perception of cycling in Ireland was also examined by proposing questions such as, "Would improvements to cycling facilities encourage (the respondent) to visit again" and, "Whether a hotel's proximity to a high quality cycling facility made one hotel preferable to another".

Section 2 consisted of four scenarios. Each scenario consisted of the same three options; however the conditions that were attached to each option varied between the scenarios. The three options were as follows:

- Option 1 – Road with cycling infrastructure
- Option 2 – Road with a cycle lane
- Option 3 – A fully segregated from traffic cycling facility.

The respondent was asked to imagine that they were sightseeing in rural Ireland by bicycle and that they were travelling between two locations. They were then asked to choose between the options with the various conditions. The conditions that varied for the scenarios were time, weather and route gradient. Images accompanied the scenarios in order for the respondent to more comprehensively visualise each option presented. The respondents were presented with scenario containing images of the options along with the conditions attached to each option. The respondent then ticked which option they would prefer under the circumstances presented. It can be seen how the options were presented in Figure 1. It should be noted that respondents were told that these images were just to give an indication of what the routes could look like and that the real routes may differ.

INSERT FIG 1

Section 3 consisted of questions that revolved around the personal details of the respondents. The questions of gender, age, country of residence, relationship status, household income, etc., were included along with some cycling related questions. The cycling related questions were about them in their country of residence. The respondent's confidence as a cyclist, how many bicycle their household owned, and whether they cycled for work/education or recreational purposes were enquired about.

3.4 Methodology for Analysis of Responses

The model used in the analysis on the tourism responses was a nested logit model. A multinomial logit model was also estimated, but the nested models had stronger rho squared values, and so it was decided just to focus on the nested models for this research. This was used in order to avoid potential violations of the IIA (independence of irrelevant alternatives) property among alternative options. The nested logit model is structured to predict the probability of a choice given the respective conditions attached to the options from which the choice was made. This model is a useful analytical and behavioural tool for investigating choice responses. Further background information on the theory that underpins the nested logit model can be found in Louvierre et al (2000) and Hensher et al (2005). A multinomial logit model assumes that the unobserved component of utility is independent over all alternatives. The utility for each alternative in a multinomial model is based solely on the attributes of that alternative. This is not realistic in many situations. In nested logit, the unobserved component of utility is correlated. This allows for differential degrees of interdependence among subsets of alternatives in a choice set. Where the multinomial model would miss correlations between alternatives, the nested model can identify these correlations. The tree structure of the nested model used in the analysis later in this paper can be viewed in Figure 2.

INSERT FIG 2

In order to model the data, utility functions needed to be formed and inputted into the software package NLogit. The model takes the following functional format:

$$U_{in} = \beta X_{in} + \varepsilon_{in} \qquad (1)$$

where *n* represents the cycle facility chosen and *i* the individual. X_{in} represents the set of explanatory variables specific to cycling facility option *n* and by individual *i*. U_{in} is the utility obtained by individual *i* and ε_{in} is a random error term, which is assumed to be identically and independently distributed using the Gumbel distribution method (Train, 2003). The utility equation structure in Eq (1) will estimate a utility value for each of the presented route options and therefore allow the potential utility of the options to be compared. The probability that individual *i* chooses route *n*, this is also conditional on that route being apart of the nest examined (for further explanation on nested logit please see Train, 2003).

When performing regression analysis such as nested logit, it is important to keep the structure of the analysis as simple as possible. For the analysis performed in this paper, the weather and gradient attributes are not linear or numerically quantifiable. Therefore it was decided to simplify these variables into binary variables. Weather was simplified to if it were dry or not (Weather = 1 if dry, 0 if not), and gradient was simplified to whether it was flat or not (Slope = 1 if flat, 0 if not). Time was a linear and numerically quantifiable attribute and therefore did not need to be simplified.

The models estimated in the analysis section of this paper use a maximum likelihood estimation approach. The models were divided to provide an insight as to how the various attributes of the facilities and how various personal characteristics of the respondents affect choices. From β_{time} for each of the options with the value of time known from the National Roads Authority (Ireland) (2011), the "Willingness to Pay" for the different standards of facility can be assessed.

Algers et al (1998) and Hensher et al (2005) estimate the value of time by dividing the estimated marginal utility of time with the estimated value of cost. The formula can be seen in Eq. 3.

$$Value\ of\ Time = \frac{\beta_{TIME}}{\beta_{COST}} \qquad (3)$$

From the estimates in Table 6, it can be seen that β_{TIME} has been estimated for the three facility types. A cyclist's value of time is also known from the National Roads Authority (Ireland) (2011). If Eq. 3 is rearranged, the marginal utility of cost can be determined for each facility. This β_{COST} allows the "Willingness to Pay" for each option to be calculated. By using "Option A - Road without cycling facilities" as our reference category, we can determine ratio for the other two options. The willingness to pay for each facility then can be estimated by multiplying the ratios between Option A and the other options, by the original value of time. By multiplying these two together, the amount a person would be willing to sacrifice in order to travel upon the options can be quantified.

4. Analysis and Results

4.1 Descriptive results

Table 2 contains the demographic results of the respondents. The gender is skewed slightly as there were more female respondents than male. The age category of 12-24 years has the largest percentage of responses. This could be attributed to some of the surveys being undertaken in a hostel (most likely due to the average age of guests in a hostel being lower than the average age of tourists visiting the country). Other than these three areas, all other personal questions had a reasonable and expected spread of responses. The actual numbers and their percentage of the total responses can be observed in Table 2.

Table 3 contains a sample selection of the more relevant questions that were asked in Section 1. The numbers per response and the percentage of the total responses are indicated. It can be seen from Table 3 that the majority of tourists surveyed were visiting Ireland for holiday/recreational purposes and the durations of the trips varied greatly. It was interesting to note that a sizeable amount of tourists had cycled or planned to cycle in Ireland. This may be due to the survey having been undertaken in Dublin city centre, where there is a convenient, successful and relatively cheap bike sharing scheme that is utilised greatly by tourists. However, only approximately 30% would recommend Ireland from a cycling perspective. This could be due to the respondents own perception of cycling, and/or of those that cycled or observed cycling in Ireland did not have a very positive experience. This was seemingly reinforced by the results from the following question where 35% would be encouraged to revisit Ireland if improvements were made to cycling facilities and infrastructure. Approximately 70% would also use a high quality cycle path that allowed access to tourist facilities if it existed near where the respondent was staying and approximately 63% would choose to stay in a hotel that was near a cycling facility over one that was not. The numbers and percentages for the questions can be viewed in Table 3.

INSERT TABLE 2
INSERT TABLE 3

4.2 Stated Preference Analysis

In the survey, respondents were presented with four different scenarios, containing three cycling facilities with varying conditions attached. In Table 4, a summary of the choices of the respondents can be seen. Each respondent provided four answers, hence the total number of responses to this section is 1,148 (4 x 287). It can be seen that the "Option C - Segregated from Traffic Cycling Facility" is very much preferred by tourists for cycling upon. The majority of respondents would be willing to sacrifice time and comfort (steeper gradients and persevere through inclement weather) in order to be fully separated from motorised traffic than to cycle along a road with either no cycle infrastructure or a road with cycle lanes. The relationship between facility chosen and time, weather, and route slope is further developed in the next part of this paper. Table 4 outlines the numbers and percentage from the scenarios section. As seen in Table 4, the choices for the scenarios are known along with the conditions attached to each scenario. This data is inputted into NLogit along with the utility functions from Equations 1, 2 and 3. Nested logit analysis was performed on the data and functions, and resulted in Table 6. NLogit estimates the coefficients for the constants and parameters (see Train, 2003 for a more in-depth discussion of these methods).

INSERT TABLE 4

The results in Table 5 show that all the estimates except one had good significance in this model. Only the weather parameter for "Option A – Road without Cycling Facilities" was found not to be significant. This could be due to people choosing a road without cycling facilities only if time is an issue and weather is not an overly influential factor. The coefficients are the beta value estimates for the utility functions specified in the methodology sections. The standard error is the standard deviation for the estimates. The Z score is the number of standard deviations by which the estimates for the coefficients differ from the mean. $|z|>Z^*$ indicates the significance (see Train, 2003 for a more in-depth discussion of these methods). The results from Table 5 make intuitive sense with all the beta coefficients being negative for time, and positive for both weather and slope. This implies that for all options, as time increases for an option, respondents are less likely to choose that option and the more flat and the better the weather is for an option, the more likely that respondent will choose that facility. From Table 5, it can be seen that when all else is held equal, the time coefficients for Option A is approximately half of the time coefficient for Option C. This implies that a tourist would be willing to increase their time approximately by 100% in order to travel upon a perceived to be safer segregated from traffic cycling facility rather than upon a road without any cycling infrastructure.

Dry weather has the biggest impact on Option B, this is followed by Option C. This implies that dry weather would be mostly the reason why a respondent would choose Option B, whereas dry weather would seemingly not be an overly controlling factor when choosing Option C. This is most likely due to tourists willing to persevere through inclement weather (sacrifice some comfort) in order to travel upon the segregated from traffic cycling facility. The dry weather coefficient is lowest for Option A, implying that it is not an overly influential factor relative to the other options, in the decision to choose Option A. It is inferred that tourists would mostly select a road without cycling infrastructure when time and the route gradient are the main issues.

The gradient coefficients are approximately equal for the three options. The coefficients vary by approximately 5% for the options. The decline is very slight but one can surmise that tourists are slightly tolerant of a steeper route gradient for better quality cycling infrastructure.

INSERT TABLE 5

The cost coefficients have been estimated from the time coefficients in Table 6. These coefficients were derived from equations used in Algers et al (1998). The ratios of the coefficients from Option A to Option B and Option C were then calculated. It can be seen in Table 6 how the cost ratio between Option A and B is 1:1.43. It can be deduced from this ratio that if there was a tangible cost for the three user facilities (a toll for instance), a tourist would be willing to pay 43% more for a cycle lane than for a road without any cycling facilities. Similarly, a tourist would be willing 91% more for a fully segregated from vehicular traffic cycling facility. The value of time is known to €27.81 an hour from National Roads Authority (Ireland) (2011). The time coefficients were estimated in minutes, therefore the value to time is €0.46 a minute. It can be seen in Table 6 how a tourist would be willing to pay €0.20 per minute to travel upon a cycle lane along a road rather than a road without any cycling infrastructure. A tourist would be willing to pay €0.42 per minute to travel along a segregated from traffic cycling facility over a road without any cycling infrastructure

INSERT TABLE 6

The Age category was the age of the respondents to the survey. This was numerically categorised with '1' representing the 12 – 24 year old age group, and rising to '6' representing the 65+ years of age group. The Gender category represents the gender of the respondents, with '1' being male and '2' being female. The income category represented the household income of the respondents, which was split into five numerically coded categories with the lower numbers representing a lower income and the higher numbers representing higher incomes. The Bikes Own category represented the number of bikes the household of the respondent owned. This category was again numerically coded into five categories with the lower numbers representing a lower quantity of bikes owned and the higher number a higher number of bikes owned. The significance for some of the estimated coefficients was less than 0.05. Weather Dry for Option A was again not significant. Income was not significant for Option A. For Option B, Age, Gender, and Bikes Owned were not significant, and for Option C, Gender and Bikes Owned were not significant.

From Table 7, it can be seen that the coefficients for the constants, Time, Weather Dry and Slope Flat have remained approximately the same without the coefficient altering by more than 10%. The significance for these coefficients have remained the same also except for Slope Flat for Option A which reduced, but not enough that it was not significant. Therefore the relationships for Time, Weather Dry, and Slope Flat have remained approximately the same as before, however, one can now see how the respondents' personal demographic information affects the choices made.

Age is negative for Option A, implying that it is more likely that a tourist with a lower age would choose a road without cycling infrastructure. The Age coefficient is positive for both Option B and Option C implying that tourists would be more mature in age that would choose these facilities. The Age coefficient is larger for Option C than for B, suggesting that more mature tourists would select Option C over Option B. The Gender coefficient for Option A is negative and quite large in scale relative to the Gender coefficients for Option B and C, implying that many more male tourists would be willing to select a road without cycling infrastructure than female. The Bikes Owned coefficients indicate that the higher the number of bicycles within the tourist's household, the more likely that the tourist will select option A and the lower the number of bikes in the tourist's household the more likely they are to select option C. It can be seen in Table 7 that the Bikes Owned coefficient for Option A is positive whereas the Bikes Owned coefficient for the Option B and C are negative. This is most likely due to if a tourist owns one bike or more, they are probably more likely to cycle in their country of residence. Therefore the tourist would be more confident in cycling and not as nervous about cycling among traffic as a tourist who would not have access to a bike in their country of residence. The negative coefficient is larger for Option C than Option B indicating that if a person has no bikes in their household, they are more likely to choose Option C.

INSERT TABLE 7

The cost coefficients are recalculated with the new time coefficients in the same fashion as they were for Table 6 and can be seen in Table 8. The ratios were again computed and then calculated with the value of time. As mentioned previously, travel time was used as a proxy for cost, however this cost is different to the willingness to pay values estimated in this section. The willingness to pay values take into account both the cost of travel time as well as preferences between the different cycle route options inherent in the coefficents. It can be seen in Table 6 that the ratio for Option B is 1.48. This indicates that if there was a tangible cost for using the cycling facilities such as a toll, a tourist would be willing to pay 48% more for a road with a cycle lane than a road without a cycle lane, all else being held equal. The ratio for Option C is 1:1.98 indicating that a tourist would be willing to pay 98% more for a segregated from traffic cycling facility than for a road without any cycling facilities. Even though the Time coefficients only changed slightly in the second model, the willingness of a tourist to pay for a road with a cycle lane increased from €0.20 per minute to €0.22 per minute, and for a fully segregated from traffic cycle facility, the willingness to pay increased from €0.42 per minute to €0.45 per minute.

INSERT TABLE 8

Conclusions

As mentioned previously, research into cycling and tourism has not been overly developed. In recent years, there has been an increased focus on research into this area. The research that presently exists is aligned more towards large scale events such as the Tour de France and the Olympics, and adventure tourism in general. This paper casts a light onto the area of cycling for tourist purposes and develops a value based system that can be used in the planning of cycling infrastructure in tourist locations and rural areas.

From results in this paper, it was observed that tourists, when presented with either a road without cycle lanes, a road with cycle lanes, and a segregated from traffic cycling facility, and all other conditions are equal, the tourist will select the segregated facility approximately 75% of the time, the road with cycle lanes 18% of the time, and the road without any cycling facilities 7% of the time. From the regression analysis performed on this data the following is now known:

- A tourist is willing to increase their cycling time by approximately 100% in order to cycle upon a fully segregated from traffic cycling facility rather than along a road without cycling infrastructure, and are willing to increase their time by 40-50% to be able to cycle along a road with a cycle lane rather than a road without cycling facilities
- Younger, male tourists, who own one or more bikes are more likely to choose a road without cycling facilities, while older, female tourists, who do not own any bikes, are more likely to choose a road with cycle lanes or a segregated from traffic cycling facility
- Female tourists are very unlikely to select to use a road without any cycling facilities, however, once there is some form of cycling infrastructure a female tourist will be satisfied, be it segregated from traffic or not. Segregation from traffic was not highly influential for females
- If there was a tangible cost to using a cycling facilities, a tourist would be willing to pay 48% more for a road with cycle lanes than for a road without cycling facilities and 98% more for a fully segregated from traffic cycling facility than for a road without cycling facilities
- Using a value of time of €27.81 an hour or €0.46 per minute, it can be deduced that a cyclist is willing to pay €0.22 per minute for a road with a cycle lane and €0.45 per minute for a fully segregated from traffic cycling facility

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Table 1
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Table 1 Attributes and Attribute Levels

Facility Type	Time	Weather	Route Slope
Road without cycling infrastructure	10 minutes	Dry	Flat
Road with cycle lanes	20 minutes	Windy	Medium
Fully segregated from traffic cycleway	40 minutes	Wet and Windy	Steep

Table 2
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Table 2 Personal Information of Respondents

Gender	Numbers	Percentage
Male	112	39
Female	169	59
No response	6	2
Total	287	100
Age		
12-24	114	40
25-34	68	24
35-44	21	7
45-54	35	12
55-64	29	10
65+	13	5
No response	7	2
Total	287	100
Where from?		
Great Britain	16	6
Other Europe	136	47
USA and Canada	86	30
Other areas	43	15
No response	6	2
Total	287	100
In your country of residence, do you cycle for:		
(a.) Work/Education purposes?		
Yes	92	32
No	151	53
No response	44	15
Total	287	100
(b.) Recreational purposes?		
Yes	201	70
No	59	21
No response	27	9
Total	287	100
Bikes in Household		
Zero	34	12
One	54	19
Two	73	25
Three or more	87	30
No response	39	14
Total	287	100

Table 3
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Table 3 Results and percentages from Questions posed in Section 1 of the Tourist Intercept Survey completed in the summer of 2012

Main reason for this Visit?	**Numbers**	**Percentage**
Holiday/Recreation	244	85
Business	4	1
Visiting friends/relatives	11	4
Mix	17	6
Other (please specify)	10	4
No response	1	0
Total	287	100
Trip Length		
Less than 5 days	70	24
5 to 8 days	53	18
9 to 12 days	85	30
More than 12 days	69	24
No response	10	4
Total	287	100
Cycled while in Ireland?		
Yes	56	20
No	225	78
No response	6	2
Total	287	100
Recommend Ireland from your experience of cycling?		
Yes	85	30
No	51	18
No response	151	53
Total	287	100
Improvements to cycling facilities encourage you to visit again?		
Yes	100	35
No	48	17
No response	139	48
Total	287	100
If where you are staying there was a high quality Greenway would you use the it?		
Yes	207	72
No	14	5
No response	66	23
Total	287	100
Choose a hotel near a high quality Greenway/cycle path over a hotel that is not?		
Yes	181	63
No	52	18
No response	54	19
Total	287	100

Table 4
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Table 4 Results from Section 2 - Scenarios

Facilities Chosen	Numbers	Percentage
Option A - Road without cycling facilities	78	7
Option B - Road with Cycling facilities	205	18
Option C - Segregated from Traffic Cycling Facility	845	73
No response	20	2
Total	1148	100

Table 5
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Table 5 Estimates for the baseline tourism model

Estimate	Coefficient	Standard Error	z	|z|>Z*
Option A - Road without cycling facilities				
Constant	-2.95***	0.36	-8.14	0.00
Time	-0.03**	0.01	-2.21	0.03
Weather Dry	0.22	0.24	0.91	0.36
Slope Flat	0.71***	0.26	2.72	0.01
Option B - Road with Cycling facilities				
Constant	-2.08***	0.29	-7.24	0.00
Time	-0.04***	0.01	-4.73	0.00
Weather Dry	0.87***	0.18	4.90	0.00
Slope Flat	0.69***	0.18	3.97	0.00
Option C - Segregated from Traffic Cycling Facility				
Time	-0.05***	0.01	-8.23	0.00
Weather Dry	0.56***	0.15	3.77	0.00
Slope Flat	0.67***	0.15	4.50	0.00
Sample	1148			
R-Squared	0.10			
Log likelihood	-721.04			
AICc	1464.1			

***** Significant at a 1% level**

**** Significant at a 5% level**

*** Significant at 10% level.**

Table 6

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Table 6 Cost coefficients estimates from the time coefficients and the Willingness to Pay of Tourists for different cycling facilities for the basic model

Estimate	**Coefficient**
Option A - Road without cycling facilities – Cost	-0.02
Option B - Road with Cycling facilities – Cost	-0.02
Option C - Segregated from Traffic Cycling Facility – Cost	-0.03
Ratio of Option A to the other options	
Option A - Road without cycling facilities – Cost	1
Option B - Road with Cycling facilities – Cost	1.43
Option C - Segregated from Traffic Cycling Facility – Cost	1.91
Value of Time	
Value of Cycling Time (€/hr)	27.81
Value of Cycling Time (€/min)	0.46
Cost of each Option per minute	
Option A - Road without cycling facilities – Cost (€/min)	€0.46
Option B - Road with Cycling facilities – Cost (€/min)	€0.66
Option C - Segregated from Traffic Cycling Facility – Cost (€/min)	€0.88
Willingness to Pay	
Extra amount that a tourist would be willing to pay for Option B over Option A (€/min)	€0.20
Extra amount that a tourist would be willing to pay for Option C over Option A (€/min)	€0.42

Table 7
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Table 7 Basic Tourism Model including Age, Gender, Income and Bicycle Owned

Estimate	Coefficient	Standard Error	z	|z|>Z*
Option A - Road without cycling facilities				
Constant	-2.21***	0.67	-3.32	0.00
Time	-.025**	0.01	-2.08	0.04
Weather Dry	0.26	0.25	1.05	0.29
Slope Flat	0.62**	0.27	2.32	0.02
Age	-0.24***	0.1	-2.58	0.01
Gender	-0.64***	0.23	-2.73	0.01
Income	0.07	0.09	0.81	0.42
Bikes Owned	0.35***	0.11	3.06	0.00
Option B - Road with Cycling facilities				
Constant	-2.44***	0.53	-4.64	0.00
Time	-0.04***	0.01	-4.68	0.00
Weather Dry	0.84***	0.18	4.74	0.00
Slope Flat	0.71***	0.18	3.99	0.00
Age	0.06	0.05	1.10	0.27
Gender	0.2	0.17	1.17	0.24
Income	0.12**	0.05	2.15	0.03
Bikes Owned	-0.05	0.07	-0.68	0.5
Option C - Segregated from Traffic Cycling Facility				
Time	-0.05***	0.01	-8.11	0.00
Weather Dry	0.58***	0.15	3.84	0.00
Slope Flat	0.7***	0.15	4.58	0.00
Age	0.08*	0.05	1.71	0.09
Gender	0.13	0.15	0.87	0.39
Income	-0.15***	0.05	-2.99	0.00
Bikes Owned	-0.07	0.07	-1.09	0.28
Sample	1148			
R-Squared	0.13			
Log likelihood	-699			
AICc	1444.0			

*** Significant at a 1% level

** Significant at a 5% level

* Significant at 10% level

Table 8
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Table 8 Cost coefficients estimates from the time coefficients and the Willingness to Pay of Tourists for different cycling facilities for the basic model

Estimate	Coefficient
Option A - Road without cycling facilities – Cost	-0.05
Option B - Road with Cycling facilities – Cost	-0.08
Option C - Segregated from Traffic Cycling Facility – Cost	-0.11
Ratio of Option A to the other options	
Option A - Road without cycling facilities – Cost	1
Option B - Road with Cycling facilities – Cost	1.48
Option C - Segregated from Traffic Cycling Facility – Cost	1.98
Value of Time	
Value of Cycling Time (€/hr)	27.81
Value of Cycling Time (€/min)	0.46
Cost of each Option per minute	
Option A - Road without cycling facilities – Cost (€/min)	€0.46
Option B - Road with Cycling facilities – Cost (€/min)	€0.69
Option C - Segregated from Traffic Cycling Facility – Cost (€/min)	€0.92
Willingness to Pay	
Extra amount that a tourist would be willing to pay for Option B over Option A (€/min)	€0.22
Extra amount that a tourist would be willing to pay for Option C over Option A (€/min)	€0.45

Figure 1

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Option A – Road with no cycling facilities	**Option B** – Road with cycle lanes	**Option C** – Fully segregated facility
		
The time on this facility is **10** minutes	The time on this facility is **40** minutes	The time on this facility is **10** minutes
The weather is **windy**	The weather is **dry**	The weather is **dry**
The gradients along this facility are **moderate**	The gradients along this facility are **flat**	The gradients along this facility are **flat**

Figure 1 Example of a Scenario Presented to the Tourists

Figure 2
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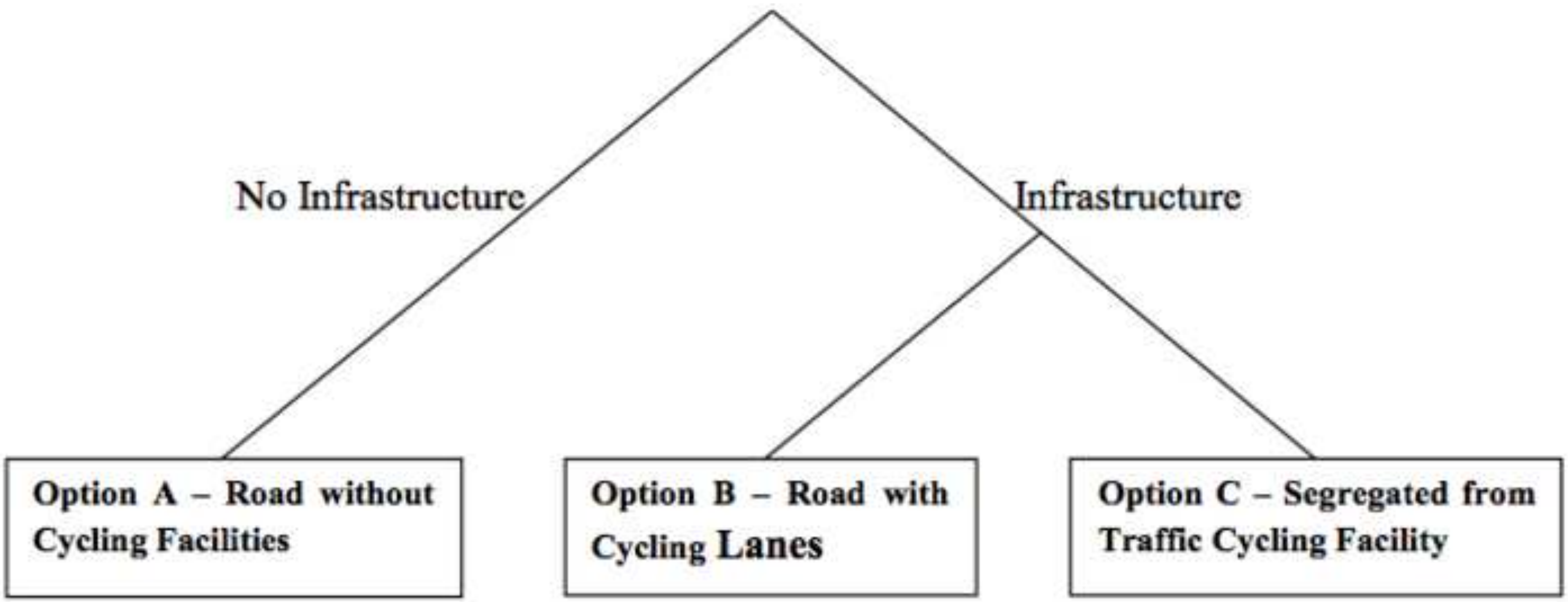

Figure 2 Tree Structure of the Nest Model

***Author Biography**

Dr Gerard Deenihan has recently completed his doctoral thesis in the in the Department of Civil, Structural and Environmental Engineering at Trinity College Dublin, Ireland. His doctoral research is examining the benefits of introducing inter-urban cycleways.

Dr Brian Caulfield is an Assistant Professor in Civil Engineering in the Department of Civil, Structural and Environmental Engineering at Trinity College Dublin, Ireland. His main areas of research are in the field of transportation, more specifically determining the benefits of the introduction of new transport schemes and the environmental impacts of transport. He has been active in transportation research for 10 years and has published over 70 peer-reviewed papers.