

PERCEPTION OF SAFETY AMONG CYCLISTS IN DUBLIN CITY

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Abstract

Non-motorized travel modes such as, walking and cycling has been recognized as critical in solving problems related to growing traffic congestion, harmful vehicle emissions and public health issues. As a result, in recent years the policy makers and practitioners are actively promoting walking and cycling as sustainable alternatives to motorized travel. Unlike walking, cycling requires sharing of road space with other modes of travel. To promote cycling in a city like Dublin, it is important to establish the safety and efficiency of the existing road transport network from a cyclist's perspective. This paper presents a study on understanding the safety behaviour and perceived safety of cyclists in the city of Dublin. A questionnaire based survey was conducted on the existing cyclists in Dublin. The survey responses were analysed in an Ordered Logistic Regression framework to identify the factors which act as motivators and deterrents in influencing the safety experience of cyclists. The findings of this analysis reaffirms that cyclists do not consider that they experience superior safety than car-drivers. This indicates that serious policy interventions are necessary to improve the safety experience of existing cyclists which in turn will motivate non-cyclists to convert to cycling.

INTRODUCTION

An increasing dependency of the society on motorized vehicles in Dublin city has raised concerns regarding growing traffic congestion, harmful vehicle emissions and public health problems. As a result, attention has returned to non-motorized means of transport to combat these issues. Walking and cycling are beginning to be promoted as sustainable alternatives to motorized vehicles. Increased use of these sustainable modes of travel would reduce vehicle numbers on the roads within the city thereby reducing traffic congestion, vehicle emissions and health problems associated with these vehicle emissions. In 2005, the cost of congestion to the Greater Dublin Area was €2.5billion [1]. This is a huge threat to the competitiveness of Dublin as a city trying to attract companies to invest in its economy. Due to these concerns the attention of policy makers has turned to encouraging sustainable modes of travel. In 2009, the Department of Transport published Ireland's first National Cycle Policy Framework (NCPF), which aims to increase the cycle mode share for commuter trips to 10% by 2020 [2]. At the time of publication this mode share stood at 1.9%. The perception of cycling as an unsafe mode of travel is a huge barrier to its popularity in

Dublin City. Information on cycling accident rates is limited, as the majority of minor accidents occur unreported to authorities. A study by Doherty et al. [3] found that only 19.2% of cycling collisions in Toronto, and 11.7% in Ottawa had been reported to the police. A report from the Irish Road Safety Authority (RSA) [4] states that between 1998 and 2008 there were 144 cyclists (43 in Co. Dublin) fatally injured and 335 (115 in Co. Dublin) seriously injured on Irish roads. Despite the percentage of fatalities among cyclists contributing only 3.5% of all road fatalities between these years in Ireland, cycling remains a low preference mode of transport due to the high number of minor incidents which have occurred unreported. In 2008, the RSA reported 192 cycling accidents resulting in minor injury. A significant factor behind increasing the popularity of cycling lies in the perceived safety of the existing and potential cyclists in relation to the existing transportation network. Transportation networks are often significantly different in terms of their available infrastructure, amenities and the behaviour of the users. The factors significantly affecting the perceived safety of cyclists are required to be established, interpreted and investigated to truly understand the travel preferences. This paper presents a study based on the city of Dublin, Ireland where the perceived safety of a large number of cyclists has been investigated through a questionnaire based survey. The key factors which influence the perceived safety of cyclists are identified from a relatively large pool of variables. The key factors have been established through an ordered logistic regression based model.

A significant amount of work is present in the field of transportation engineering employing Logistic Regression (LR) models to relate to accidents [5,6,7,8] and route choice options [9,10]. Logistic regression is a powerful tool in establishing probabilities related typically to binary choices. However there can be ordinal dependent variables for which an extension of the binary model, an ordered logistic model may be used successfully.

DESCRIPTION OF SURVEY DATA

Dublin City is the capital of Ireland and the largest city in terms of area, residing and working population of the country. The cycling mode share in Dublin city stood at 3.2% in 2006 [11]. This is higher than the average rate in Ireland, but remains far below the 2020 target set out in the NCPF. In comparison with cycling friendly countries and cities, this is still extremely low. Cycling mode shares in countries like Netherlands, Denmark and Germany are on an average between 10%-26% with some cities reaching 35%-40% [12]. The mode share for cycling in Amsterdam is 27% while it is as high as 37% for Copenhagen [13]. Additionally, it is important to note that through appropriate safety management, Copenhagen has been able to reduce the number of seriously injured cyclists for the last three decades despite a significant upward trend of number of kilometers cycled.

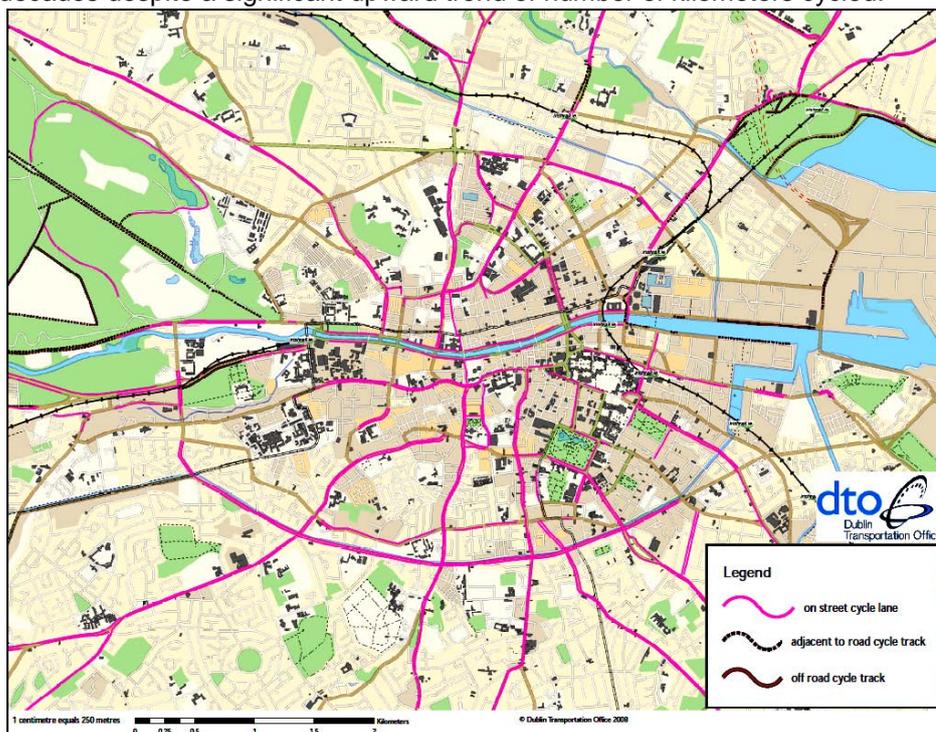


FIGURE 1 Map of current cycling facilities in Dublin City.

The transport network in Dublin, however, is primarily designed for the use of private vehicles. Other main modes of motorized transport in Dublin City are Dublin Bus, Luas (tram), Dublin Area Rapid Transport (light rail) and Commuter trains (suburban railway networks). The network also contains approximately 120km of on-road cycle tracks, 50kms of shared bus-cycle lanes and 25kms of off-road cycle tracks. Figure 1 presents a map published by the Dublin Transportation Office in 2008 of the available cycling facilities. Despite the presence of these facilities there exist many threats to cyclists in Dublin. Vehicles frequently make unforeseen stops and turns, forcing cyclists into oncoming traffic from behind. Cycle lanes end abruptly, exposing cyclists to suddenly share their commuting space with other modes of high speed-differential. These conditions naturally lead to perceived and actual discomfort and a lack of safety for the cyclists. Cycling surfaces are poorly maintained, often resulting in falls causing injury and damage to property. The attitude of other users and travel modes in the transport network such as pedestrians, buses, taxis, car-drivers etc. also affect the perception of safety of cyclists. The use of safety accessories, though not mandatory, influences the perception of safety of a cyclist.

TABLE 1 Description of Survey Responses

| | Inexperienced 36 2.08% | | Competent 871 50.29% | | Highly Skilled 825 47.63% | |
|--|----------------------------------|-------|--------------------------------|--------|-------------------------------------|--------|
| Regularity of cycling (days/week) | | | | | | |
| 3 to 5 days a week | 14 | 0.81% | 170 | 9.82% | 56 | 3.23% |
| 6 to 7 days a week | 20 | 1.15% | 519 | 29.97% | 419 | 24.19% |
| | 2 | 0.12% | 182 | 10.51% | 350 | 20.21% |
| Time spent cycling on an average | | | | | | |
| Less than 30mins | 17 | 0.98% | 325 | 18.76% | 209 | 12.07% |
| 30 mins to 1 hour | 17 | 0.98% | 418 | 24.13% | 415 | 23.96% |
| More than 1 hour | 2 | 0.12% | 128 | 7.39% | 201 | 11.61% |
| Time spent cycling on an average | | | | | | |
| Less than 30mins | 30 | 1.73% | 585 | 33.78% | 429 | 24.77% |
| 30 mins to 1 hour | 6 | 0.35% | 145 | 8.37% | 155 | 8.95% |
| More than 1 hour | 0 | 0.00% | 141 | 8.14% | 241 | 13.91% |
| Distance cycled on an average | | | | | | |
| Less than 5 kms | 26 | 1.50% | 372 | 21.48% | 225 | 12.99% |
| 5.1 to 10 kms | 6 | 0.35% | 224 | 12.93% | 209 | 12.07% |
| 10.1 to 15 kms | 2 | 0.12% | 124 | 7.16% | 137 | 7.91% |
| More than 15 kms | 2 | 0.12% | 151 | 8.72% | 254 | 14.67% |
| Distance cycled on an average day | | | | | | |
| Less than 5 km | 32 | 1.85% | 619 | 35.74% | 425 | 24.54% |
| 5.1 to 10 kms | 2 | 0.12% | 74 | 4.27% | 102 | 5.89% |
| 10.1 to 15 kms | 1 | 0.06% | 50 | 2.89% | 47 | 2.71% |
| More than 15 kms | 1 | 0.06% | 128 | 7.39% | 251 | 14.49% |
| Average Travel Speed | | | | | | |
| Less than 10 km/hr | 5 | 0.29% | 45 | 2.60% | 11 | 0.64% |
| 10 to 20 km/hr | 15 | 0.87% | 409 | 23.61% | 317 | 18.30% |
| More than 20 km/hr | 0 | 0.00% | 148 | 8.55% | 334 | 19.28% |
| Don't know | 16 | 0.92% | 269 | 15.53% | 163 | 9.41% |
| Gender | | | | | | |
| Male | 4 | 0.23% | 445 | 25.69% | 654 | 37.76% |
| Female | 32 | 1.85% | 418 | 24.13% | 167 | 9.64% |
| Age | | | | | | |
| Less than 25 years old | 19 | 1.10% | 283 | 16.34% | 255 | 14.72% |
| 25 to 44 years old | 11 | 0.64% | 400 | 23.09% | 423 | 24.42% |
| 45 to 64 years old | 0 | 0.00% | 98 | 5.66% | 90 | 5.20% |
| More than 64 years old | 0 | 0.00% | 7 | 0.40% | 4 | 0.23% |

To understand which aspects of the transport network prove most hostile to cyclists, a detailed analysis is required to track the factors that most strongly affect the perceptions of safety of the cyclists in this network. There seems to be an image being created among the population of Dublin of cycling as an unsafe mode of travel. Such an image may negatively affect the popularity and the choice of cycling as a clean, sustainable, efficient and healthy mode of travel. To understand and establish the perceptions of the current cyclists is the first step to be able to create a network in which cyclists can feel safe.

A questionnaire based survey was conducted in Dublin to analyze the safety behaviour and perceived safety of cyclists in Dublin city. 1954 responses were collected from existing cyclists in Dublin, of which 1732 responses were eligible for use in the analysis. It was decided to focus on the experiences and perceptions of existing cyclists, as this is the population that has firsthand knowledge of the safety problems and concerns associated with cycling in Dublin. Table 1 gives a description of the existing cyclists in Dublin. Of the respondents 63.7% were male. The majority of these cyclists were less than 45 years old. Above 45 years, the number of cyclists dramatically decreased. The average distance cycled on a weekday is 9.54kms and 6.85kms at the weekend and the average time spent cycling on a weekday is 42.6mins and 31.9mins at the weekend.

Table 1 shows that generally cyclists travel at speeds of 10-20 km/hr, although a great number of those describing themselves as highly skilled travel at higher speeds. It can be seen that, almost 98% of the respondents in Dublin would describe themselves as being either a competent or highly skilled cyclist. Consequently, it is of significant concern if confident cyclists perceive the network to be potentially unsafe from a number of perspectives.

Figure 2 shows the preference of each experience group to where they cycle. Among all groups there is a strong preference to avoid urban roads, although it can be seen that the tendency lessens slightly with experience. This may be because of the high traffic volumes, higher traffic speeds and sometimes a larger number of vehicle lanes all induce a feeling of vulnerability among cyclists. In contrast, more than half of the respondents would prefer the use of parks and scenic trails in which to cycle. These facilities usually offer a more pleasant and relaxed experience for a cyclist as they are separated from traffic.

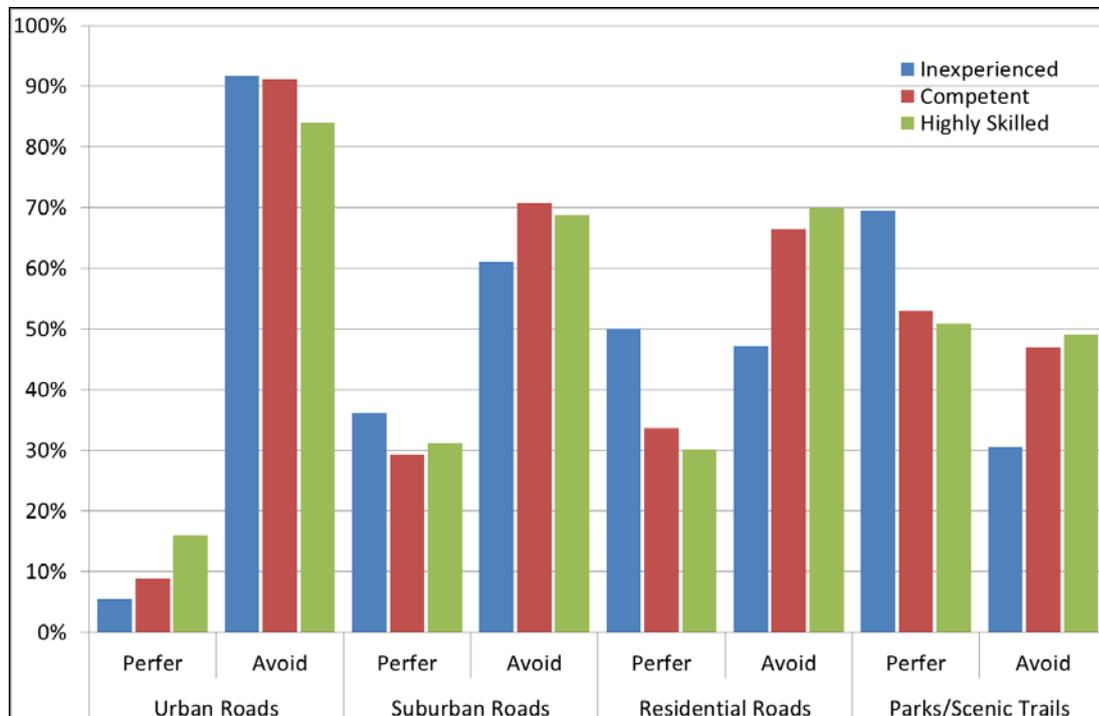


FIGURE 1 Preference of cyclists to type of road, according to cyclists' experience.

In figure 3, the perception of safety among respondents while cycling in comparison to driving a car in Dublin city is studied. It can be seen that even adventurous and balanced cyclists view cycling as somewhat less safe or much less safe than driving. If cycling is to become a popular mode of transport in Dublin, this is a problem which must be addressed.

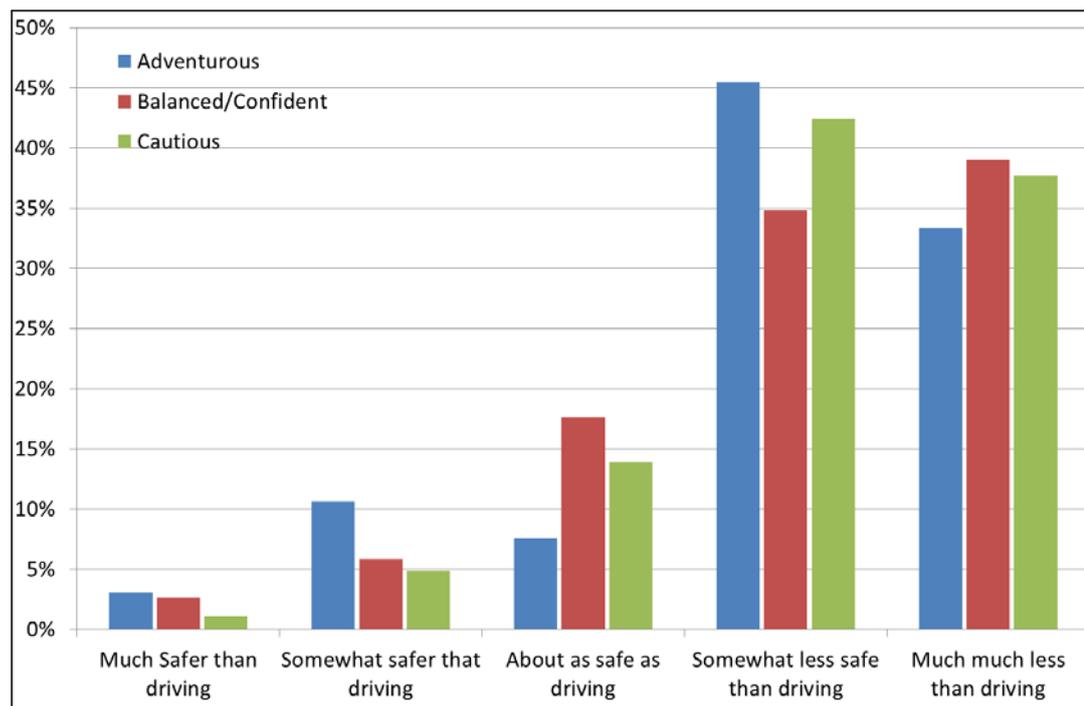


FIGURE 2 Views of cyclists when comparing cycling with driving in Dublin, according to cyclists' confidence

PERCEIVED SAFETY MODEL

The perceived safety model looks at different cyclist attributes to investigate how cyclists perceive their safety as compared to driving in Dublin. This is carried out employing an Ordered Logistic Regression (OLR) model. As with other forms of logistic regression, OLR uses maximum likelihood estimation. It differs in how the variables are presented in the model; instead of binary values (0 or 1), there may be more than two values, ordered from low to high.

TABLE 2 Coefficients, Odds Ratio, Standard Errors for the Perceived Safety Model

| Is cycling safer than driving in Dublin? | Coef. | Odds | Std. | [95% Conf.] | |
|---|--------|---------|-------|-------------|--------|
| Gender | 0.794 | 0.825 | 0.118 | 0.133 | 1.456 |
| Age | 0.042 | 1.016* | 0.006 | -0.247 | 0.331 |
| Regularity of cycle | -0.053 | 1.170** | 0.049 | -0.773 | 0.666 |
| Cyclists experience | 0.147 | 1.159 | 0.156 | -0.117 | 0.412 |
| Balanced cyclists | -0.445 | 1.043 | 0.154 | -0.732 | -0.158 |
| Confident cyclists | -0.461 | 0.948 | 0.348 | -0.806 | -0.116 |
| Distance travelled | 0.157 | 1.001 | 0.002 | 0.074 | 0.240 |
| Use of urban roads | 0.001 | 1.700** | 0.315 | -0.003 | 0.005 |
| Use of suburban roads | 0.530 | 1.055 | 0.165 | 0.167 | 0.894 |
| Use of residential streets | 0.053 | 1.167 | 0.176 | -0.254 | 0.360 |
| Use of park/scenic trails | 0.154 | 1.031 | 0.170 | -0.142 | 0.451 |
| Use of cycle lanes on the footpath | 0.030 | 0.863 | 0.121 | -0.293 | 0.353 |
| Use of off road scenic cycle paths | -0.147 | 1.033 | 0.176 | -0.423 | 0.128 |
| Use of curb-side cycle lanes | 0.033 | 0.837 | 0.112 | -0.302 | 0.367 |
| Use of shared bus-cycle lanes | -0.178 | 1.173 | 0.185 | -0.440 | 0.085 |
| Use of roads with no cycle facilities | 0.160 | 1.765** | 0.276 | -0.149 | 0.468 |
| Use of helmets | 0.568 | 0.790 | 0.113 | 0.262 | 0.875 |
| Use of bright coloured/hi-visibility clothing | -0.236 | 0.637** | 0.090 | -0.516 | 0.044 |
| Use of reflective accessories/lights | -0.451 | 0.861 | 0.171 | -0.729 | -0.173 |
| Full compliance with rules of the road | -0.150 | 1.928* | 0.543 | -0.538 | 0.238 |
| General compliance with rules of the road | 0.657 | 2.213* | 0.747 | 0.105 | 1.209 |
| Attitude of driver towards cyclists is usually reckless | -0.193 | 0.641** | 0.094 | -0.474 | 0.088 |
| Attitude of driver towards cyclists is always reckless | 0.016 | 0.631** | 0.111 | 0.004 | 0.028 |

** represents a *p* value of 0.01, * represents a *p* value of 0.05

Table 2 indicates that age, regularity of cycling (number of days each week), use of urban roads, use of roads with no cycle facilities, use of bright coloured/hi-visibility clothing, compliance with the rules of the roads and the attitude of vehicle drivers are all significant factors in the consideration of whether cycling is safer than driving in Dublin.

The probabilities of describing cycling as safer than, as safe as or less safe than driving are calculated for each variable and displayed in figures 4 and 5. Figure 4 indicates cycling is considered less safe than driving in all cases except with regard to compliance with the rules of the road. In this case, it is quite interesting to see that people who claim to always follow the rules of the road are much more likely to describe cycling as safer than or as safe as driving in Dublin. As the number of days people cycle each week increases that probability of describing cycling as safer than driving in Dublin also increases and the probability of describing it as less safe decreases. The probability of describing cycling in Dublin as safer than driving is larger for people who prefer to cycle on urban roads and on roads with no cycle facilities than for those who prefer not to. The probabilities of a cyclist, who does not wear bright coloured/hi-visibility clothing, describing cycling as safer than and as safe as driving in Dublin are both larger than for those who do.

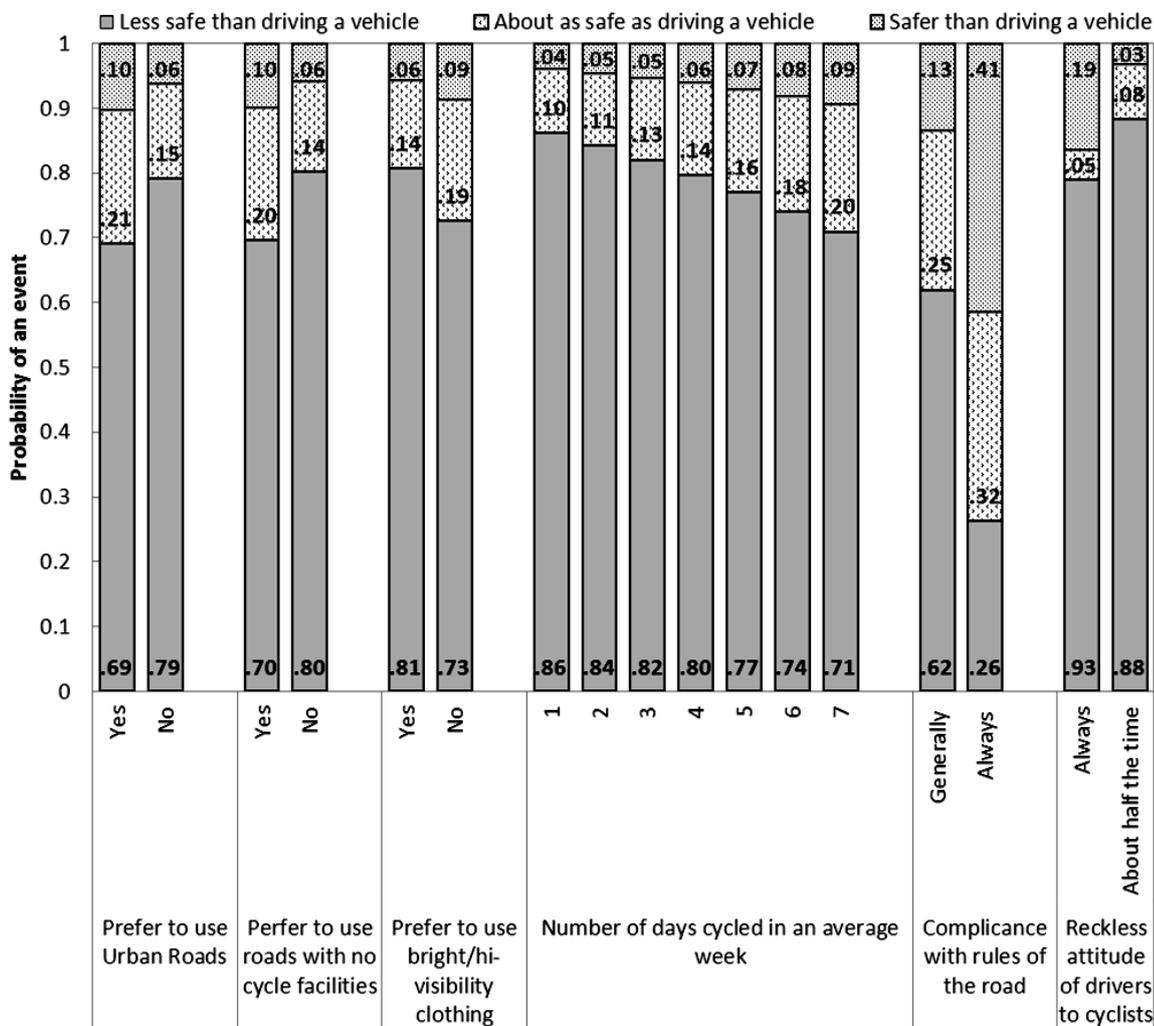


FIGURE 4 Probability of an event for various factors of the model

Figure 5 presents the probability of cycling being perceived as a safe mode when compared with driving in Dublin according to the age of the cyclists. It is interesting to observe that the probability of describing cycling as safer than or as safe as driving grows with age. Consequently, older people are more likely to deem the network as safer than the relatively younger population. The observation is also of concern, since it is the younger population who are the significantly newer additions to the

growing cycling mode share in Dublin. Additionally, it is the younger population who will probably play a major role in influencing the growth and evolution of cycling as a preferred choice of mode.

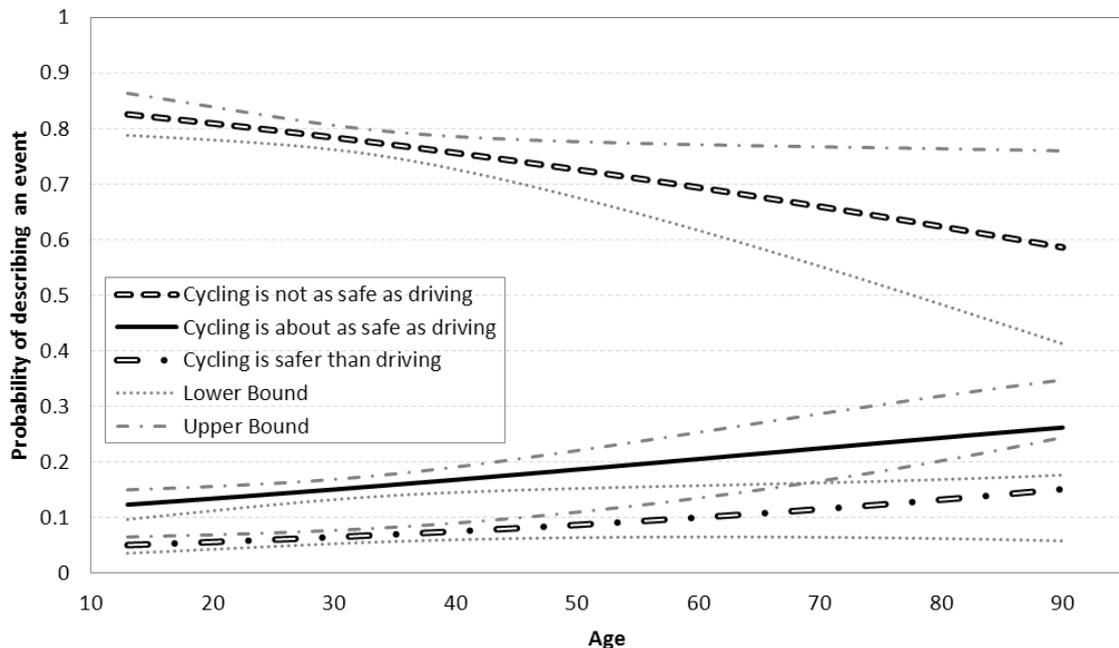


FIGURE 5 Probability of describing cycling as being, safer, about as safe or less safe than driving according to age of cyclist

CONCLUSION

The paper presented one of the first studies on the influence of the elements of the transport network which the cyclists interact with on a regular basis but might be viewed as a hindrance towards their safety. A questionnaire based survey was conducted on 1954 cyclists in the city of Dublin, Ireland to gain an understanding of their perception of safety while cycling. The responses have been analyzed using an ordered logistic regression structure. The main conclusions drawn from the model are as follows:

- It is highly probable, that a cyclist will describe cycling as less safe than driving among all cyclists groups, except those who claim they always follow the roads of the road. Consequently, in order to improve the perceived safety of cycling in Dublin, cycling policies need to place focus on the encouragement and education of cyclists to comply with the rules of the roads.
- With an increasing number of days cycled per week, the probability of considering cycling as less safe than driving in Dublin falls. Therefore, policies which encourage regular cycling activities such as the 'Bike to Work' scheme should be expanded and further encouraged.
- Young cyclists show a higher likelihood of identifying cycling as less safe than driving, than older cyclists. As it is the younger population which will govern the future development of the transport network it is vital that this population feels safer cycling within Dublin's transport network, if a sustainable transport structure is to be created.
- Those who prefer to make use of roads with no cycle facilities are more likely to describe cycling as safer than driving than those who prefer to avoid such roads. Therefore, increasing the perceived safety of cycling is dependent on creating a network in which those who currently avoid roads with no cycling facilities feel sufficiently safe and comfortable under conditions where cycling facilities are not present.

To increase the modal share of cycling in Ireland it is important to convert non-cyclists to beginner cyclists. Safety is the key concern of a beginner cyclist. Learning from the safety experience of the existing cyclists on a network is the only way of improving the safety experience of the beginners.

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