The Effect of Coloured Surfacing on Drivers' Compliance with Cycle and Bus Lanes

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Abstract

This study focuses on the effect of coloured surfacing on car driver compliance with cycle and bus lanes in Edinburgh city.

The City Council of Edinburgh has been progressive in developing a strategy to increase cycling and public transport. Edinburgh City Council first published its Local Transport Strategy in 2000 a document approved by both Council and the Scottish Executive. This Strategy was updated in 2004 and the current strategy will run until 2007.

Edinburgh City Council aspires to have a transport system that is accessible to all and serves all. This transport system should contribute to better health, safety and quality of life, particularly for children, and elderly and disabled people. The transport system should support a strong, sustainable local economy.

As part of this strategy Edinburgh city council aims to reduce the congestion created in the city by car drivers by attempting to increase the proportion of journeys made by public transport or cycling.

To increase the use of buses Edinburgh City Council propose to have an increase in the number of Greenways in the city leading to a reduction in travel times and to increase cycle use they propose to have cycle lanes or paths on all main roads with speed limits over 20 mph and no bus lanes. They also propose to improve safety for all road and transport users for cyclists this could include the colouring of cycle lanes.

It was the objective of this study to find out whether car drivers were more likely to comply with coloured cycle and bus lanes over those which are uncoloured and to consider the attitudes of cyclists and car drivers towards coloured and uncoloured cycle lanes.

The method which was used to achieve results on how car drivers complied with cycle and bus lanes was by carrying out observation surveys of a number of different areas with coloured and uncoloured cycle and bus lanes. To achieve results on the attitudes and behaviour of car drivers and cyclists towards coloured and uncoloured cycle and bus lanes a questionnaire of car drivers and a questionnaire of cyclists were carried out.

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Acknowledgements

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Chapter 1
Introduction

Background: 1.1

The purpose of this dissertation is to investigate if the coloured surfacing of cycle and bus lanes has an effect on whether car divers comply with them.

This research will be carried out in Edinburgh city and the results should indicate that there is an advantage in having coloured cycle and bus lanes.

Since 2000 when Edinburgh City Council first published its Local Transport Strategy there has been an attempt by Edinburgh City Council to increase cycle and bus use throughout the city of Edinburgh. The increase of cycle and bus lanes has been part of that strategy along with increasing the number of coloured cycle and bus lanes.

Objectives: 1.2

The objective of this project is:

(1) To see how car drivers comply with cycle and bus lanes when they have a coloured surfacing or an uncoloured surfacing by conducting observations of similar types of coloured and uncoloured cycle and bus lanes.

(2) To consider the effects that car driver's compliance or non compliance with cycle and bus lanes has on cyclists by conducting questionnaires of a significant number of cyclists.

(3) To consider the effect of coloured surfacing of cycle and bus lanes on whether a car driver will or will not comply with cycle and bus lanes by conducting questionnaires of a significant number of car drivers.

(4) To look at the policies of Edinburgh city council with regard to coloured cycle and bus lanes and to see can any improvements be made.

This topic was chosen by the author because of an interest in this area. There has been very little research done into the advantages of having coloured surfacing and this dissertation aims to consider the main benefits of colouring cycle and bus lanes.

Scope of study: 1.3

As part of this study visual observations of 12 different locations were carried out these are 3 locations being studied for each type of lane.

Questionnaires of cyclists and car drivers will also be carried out to find out the opinions and attitude towards the colouring of cycle and bus lanes.

Structure of study: 1.4

The dissertation will be arranged as follows. Firstly literature which is relevant is analysed under three headings in Chapter 2, these are the councils transport strategy, specific strategy for cycling and a case study comparing conventional bus lanes with Greenways.
Chapter 3 will outline the methods of how the study was conducted with Chapter 4 reporting the results of the study and giving some conclusions to the study. Chapter 5 will give an overall conclusion to the issues raised in the study along with making some recommendations to those with an interest in this project.

Chapter 2
Literature review

Introduction: 2.1

As part of this study a literature review has been conducted to look at any research which has been previously conducted, or any official documents which contain information regarding coloured cycle and bus lanes.

Having spent considerable time researching books and journals relating to cycle or bus lanes it was found that there was a distinct lack of information with regard to the effect of coloured surfacing on car driver compliance with cycle and bus lanes. However having conducted further research the internet has provided a number of sites and documents which relate generally to this area of study.
In Edinburgh the colour of cycle lanes is red while the colour of bus lanes is green, this is not the case throughout the rest of Britain as some cities colour there cycle lanes green while colouring there bus lanes red. However, not all of cycle and bus lanes are coloured in Edinburgh and this provides the opportunity to compare them in this research.

Greenways are priority bus lanes, introduced in 1997 as part of Edinburgh's transport strategy, Moving Forward. The concept Greenways involved the phased introduction of 26 kilometres of bus lanes on 5 routes within Edinburgh city, representing an increase of three times what was already there. Phase 1 implemented measures along the A8 and A900 corridors. A further 3 routes were then opened in late 1998. Now the majority of bus lanes in Edinburgh are Greenways. (Scottish Executive CRU, 1999)

'A Traffic Regulation Order bans general traffic from Greenways, restricting access to buses, taxis and cycles. Greenways differ from conventional bus priority in a number of ways'. They have a green tarmac surface and have red lines instead of the conventional yellow. Side streets off the Greenway will have traffic calming measures while the Greenway itself will have better provision for cyclists and pedestrians. (Scottish Executive CRU, 1999)

In Edinburgh bus lanes which are coloured are called Greenways due to their colour, and are not only for bus use but are also used by taxis and cyclists. The Greenways may be used by other motorists outside designated hours which are 7.30am - 6.30pm Monday to Friday and 8.30am - 6.30pm on Saturdays. Greenways and conventional bus lanes in Edinburgh are enforced in very differently. Greenways are constantly patrolled between 7.30am - 6.30pm by 35 Traffic Wardens and 5 supervisors on any one day while conventional lanes only receive 'visits' commencing after 8.00 am by parking attendants.
(Scottish Executive CRU, 1999)

There are many advantages of Greenways, they improve journey times of buses thereby encouraging the use of public transport and make bus services more reliable, pollution from buses is reduced, cyclist's safety is improved and there is a general reduction in accidents as a result of motorists pulling out from behind stopped buses. (Greenways: City of Edinburgh Council, 2004)
In addition to Greenways, there are also some small cycle lanes in Edinburgh. These lanes are red in colour and as the name and size indicate, these lanes are solely for cyclists' use. (Road markings: City of Edinburgh Council, 2004)

Additional information on cycle and bus lanes: 2.2

Colouring of lanes: 2.2.1

Recently there has been some discussion in Edinburgh city council with regard to the effectiveness of the colouring of cycle lanes and how the colouring effects the environment visually. The council believe that the coloured surfacing of cycle lanes detracts from the appearance of Edinburgh's World Heritage Area, which is in central Edinburgh. As a result coloured cycle lanes in this area may not be re-coloured when the colour wears. Unfortunately coloured surfacing wears considerably and may loose much of its effectiveness as over a period as short as 18 months, the pigment wears from the aggregate and the red pigmentation remains only in the resin, but even there it begins to fade.

Cycle lane widths: 2.2.2

When considering cycle lanes and their effects on the use of cycling as a mode of transport, the width of cycle lanes must also be considered. The advised maximum width of cycle lanes is 2.5 metres and may be used where the expected flow of cyclists exceeds 150 cycles/peak hour. However, if this width of cycle lane narrows the motorist's lane to a width which would be considered inoperable, a segregated facility for cyclists should be considered as an alternative. The desirable minimum width for a cycle lane is 2.0 metres as this enables cyclists to pass each other safely within the cycle lane. The absolute minimum width of cycle lane should be 1.5 metres as this allows cyclists to avoid obstructions such as gullies and debris, however a limiting width of 1.2 metres may be of value in specific circumstances where the available width of road is restricted, an example of this is at road junctions.
(The Traffic Signs Regulations and General Directions 1994)

Combined Cycle and bus lane widths: 2.2.3

Bus lanes or Greenways are use by buses, and cyclist where heavy traffic flows or lack of space prevents separate cycle lanes. Their purpose is to provide an advantage for public transport and cyclists with regard to travel time and also their safety.

However, when bus and cycle lanes are combined it must be insured that cyclists do not prevent the advantages gained in travel time for buses by delaying buses due to an insufficient width of lane for the bus to pass. It should also be insured that the frequency of buses benefits cyclists. The people that must be consulted when combining a cycle and a bus lane are the transport authorities, operators and the police.

There are three different categories of lane width for a combined cycle and bus lane. The first is the desirable minimum width of 4.6 metres which allows for an advisory cycle lane width of 1.5 metres to be provided within the bus lane, this usually allows a bus to pass a cyclist within the bus lane. The second is the absolute minimum width of 4.25 metres which allows for a limiting cycle lane width of 1.2 metres within the bus lane allowing a bus to pass a cyclist within the bus lane with amenity being affected. The third category is a limiting width of 3 metres can be used preferably for lengths not greater than 100 metres if bus stops are not within the bus lane or where bus flows are low, the bus will have to straddle the bus lane and ordinary traffic lane to pass a cyclist.

(The Traffic Signs Regulations and General Directions 1994)

City of Edinburgh Council's Local Transport Strategy: 2.3

Introduction: 2.3.1

The City of Edinburgh Council first published its Local Transport Strategy in 2000 and this document has since upgraded by the Local Transport Strategy for 2004 – 2007, which was approved by Council and the Scottish Executive in January 2004. This strategy is now council policy and a brief outline of some of the issues dealt with under this strategy that have a bearing on this project are outlined under the headings below.

A Local Transport Strategy: 2.3.2

The purpose of this Local Transport Strategy is outline transport policies, plans and projects for the transport system in Edinburgh. This document is the council's vision and strategy on how they should improve Edinburgh's transport system by outlining a vision for transport for the next 20 years, and giving a detailed account of this for the years 2004 – 2007. This strategy is important as it is required in order to bid for funds from the Scottish Executive for transport related schemes.

The vision for Transport in Edinburgh: 2.3.3

The vision for transport in Edinburgh set out in this document is to provide a transport system that is accessible to all and that serves all. To do this Edinburgh's transport system should contribute to better health and safety especially for children and elderly or disabled people.

'The Council will seek to maximise people's ability to meet their day to day needs within short distances that can easily be undertaken without the need to use a car. The city should develop and grow in a form that reduces the need to travel longer distances, especially by car. Choice should be available for all journeys within the city'.

This vision would be considered to be a balanced transport strategy as it tries to provide choices for all journeys to and within Edinburgh. This strategy helps cars to be used in the areas where they perform efficiently while discouraging car use in areas where they are inefficient. It also realises that it is crucial to have an integrated transport system to ensure that those without access to a car can access work and amenities within the city.

To ensure that the transport system within Edinburgh is effective congestion within the city must be controlled. To do this Edinburgh's Local Transport Strategy focuses on, ensuring that the car is not the only option available for as may different journeys as possible and putting measures in place to tackle congestion in problem areas.

Updates from original policy: 2.3.4

Edinburgh's Local Transport Strategy for 2004 - 2007 has had a number of updates from the first edition strategy of 2000 due to the introduction of new legislation, new transport projects and new structures for delivering these projects. Some of the aims of the 2004 – 2007 strategy are to improve road safety for all users and also reduce the environmental impact of travel.

Some of the main objectives set out for the transport policy in Edinburgh city are to:

- Reduce congestion within the city while increasing the percentage of journeys made by walking or cycling.
- Reduce need to travel especially by car.
- Ensure that all roads, paths and cycleway are sufficiently safe and convenient to use.

Progress since the introduction of Edinburgh's Local Transport Strategy: 2.3.5

The following table gives a breakdown of the different modes of transport used by residents of Edinburgh to get around the city in recent years and gives targets to be achieved by 2010.

Fig 2.1

Year	Cycle	Walk	Public Transport	Car	Other
1999	1.6	23.8	15.7	56.9	2.1
2000	0.8	23.5	16.7	56.0	3.0
2001	1.8	25.3	17.8	52.8	2.2
2010 Target	6.0	26.0	23.0	45.0	-

Figures shown are percentages of all trips undertaken by Edinburgh residents for each mode of transport; sourced from Scottish Household Survey.

Some of the target figures set out by the council in this table seem to be optimistic especially for cycling where there was very little improvement in the percentage of people cycling between 1999 and 2001. The most important issue for the city of Edinburgh council is to reduce the percentage of car journeys, as this would have the most significant effect on the level of congestion within the city. This table shows that there has been a 4% reduction in car journeys over the three years and there has been a 2% increase in the percentage of public transport journeys. These figures would seem to indicate that there is a move away from car use, which has lead to an increase in public transport journeys and as a result if these trends continue it may be possible to achieve the target set for percentage car use in 2010 which would reduce congestion within Edinburgh city.

To achieve a higher percentage of trips in Edinburgh using public transport the council intend to introduce more bus priority schemes in Edinburgh. A large number of bus shelters will either replaced or upgraded and the St Andrews Square bus station will be updated.

Also there was approval for the central Edinburgh traffic management scheme that will made both cycling and bus use more convenient. For the improvement of cycling facilities within Edinburgh, 21 new cycleways were introduced throughout the city, these are both on and off road lanes.

Current strategies: 2.3.6

Traffic congestion in Edinburgh is considered to be the most serious transport problem within the city. It is forecasted that if traffic growth continues to grow at its current rate congestion will double by 2016. To prevent congestion from getting to a stage where it becomes unmanageable the City of Edinburgh Council are trying to develop viable alternative transport options other that the car, however this will require a dramatic increase in funding.

One of the solutions considered for the reduction of traffic congestion was the introduction of congestion charges within central Edinburgh. This system has successfully been introduced in London and not only would it reduce the number of cars entering into the city but it would also create funds for the improvement of infrastructure such as Greenways and cycle lanes throughout the city along with providing funds for the improvement of public transport services.
To introduce congestion charging in Edinburgh a referendum of Edinburgh residents was held in 2005. The introduction of congestion charges was firmly defeated in this referendum and as result congestion charges could not be introduced. The council firmly believe that as congestion charges were not introduced traffic levels will continue to grow and as a result congestion and pollution within the city will increase.
(Local Transport Strategy (LTS) 2004-2007)

Cycling in Edinburgh: 2.4

Edinburgh city council aim to make cycling an attractive and safe option for the short to medium distance trips within the city.

Issues: 2.4.1

Cycling as a mode of transport is a cheap and healthy mode and is a very effective way to travel for short and medium distance trips. Even though cyclists require very little space and cycling facilities are inexpensive, cyclists are often forced to use facilities originally designed for pedestrian or general traffic use, and this makes them feel unsafe. The biggest reason for not cycling given by people is that they believe there is a high risk of being involved in an accident. As a result of this risk only 1.8% of trips within Edinburgh are made by bicycle.

With such a small percentage of trips made by cycling there is huge potential here for further growth, if higher quality facilities were provided to encourage an increase in cycling. If there was a significant uptake in cycle use it would decrease the levels of congestion and pollution in Edinburgh. In two surveys carried out by the council, on why people in Edinburgh do not cycle it was found that the main reasons for not cycling are safety and lack of storage and parking. (Cycling: City of Edinburgh Council, 2004)

Edinburgh City Council aim to increase both the amount of walking and cycling within Edinburgh city by making the experience more enjoyable. To do this they aim to remove some of the obstruction and danger created by traffic.

Some of the projects which have been undertaken to make cycling a more attractive option for short and medium distance journeys are:

- Creating cycle lanes on all main roads with a speed limit greater than 20 mph.
- Advanced stop lines on cycle lanes.
- Cycle friendly design of roads paths and crossings.
- Secure bicycle parking.

(Cycling: Local Transport Strategy (LTS) 2004-2007)

Strategy: 2.4.2

As part of Edinburgh's Local Transport Strategy they plan to develop a cycle network so that no one in Edinburgh lives more than 400 metres from the nearest route. They also plan to have sufficed cycle parking spaces to correspond with the percentage of trips to be made by cycling set out in the Local Transport Strategy. Areas which already have significant cycle use will be prioritised in the installation of cycle parking.

In the short term the council will review existing cycle facilities and due to this review a low cost programme will be introduced to maximise the quality of existing cycling facilities. Also in the short term the council wishes to complete the Edinburgh south central and the North - South cycle routes along with continuing the programme of advanced stop lines.

In the medium term the council wish to develop places to park bicycles in tenement stairs.
In the longer term the council have a number aims which will depend on the availability of funds. These aims include the replacing or modifying existing roundabouts to make them safer for cyclists and expanding the programme of parking bicycle in tenement stairs.
(Cycling: City of Edinburgh Council, 2004)

Case Study: Comparing of Greenways and Conventional Bus Lanes: 2.5

Introduction: 2.5.1

It was Edinburgh city councils transport strategy to provide an enhanced bus priority scheme and as a result Greenways have been introduced. The Greenways scheme aimed to improve bus reliability while reducing journey times. It also aims to reduce car traffic growth by 30% by 2010 and meet European guidelines on nitrogen dioxide (NO2) concentrations in the air by 2000. To achieve these aims it is hoped that Greenways will help solve the problems with conventional bus lanes and attract a larger number of passengers on buses thereby reducing car traffic growth.

Description of study: 2.5.2

This study looks at two Greenways corridors that were introduced in 1999. The A8 is 6.7km long and 55 per cent of its length is inbound bus lane, whilst 54 per cent of it is outbound bus lane. The A900 is 2.2km long and 23 per cent of its length is inbound bus lane, whilst 41 per cent it is outbound bus lane. These two Greenways were compared with the A7/A701 corridor, which has conventional bus only lanes on both sides for most its 3km length.

The scheme cost approximately £500,000/km in comparison with £110,000/km for the traditional or conventional bus lane.

As part of this study conducted in 1999 strong support was shown for the introduction of Greenways by bus operators, residents and businesses, in the areas where Greenways had already been introduced. The two main bus operators are Lothian buses and First bus and the services run every 12 minutes.

Journey times: 2.5.3

The surveys have showed that, in most cases, both Greenways and conventional bus lanes protected buses from the congestion that affected other traffic. Greenways that were lined with shops provided better protection from congestion than the equivalent stretch of conventional bus lane, as less cars parked in them. The introduction of Greenways on the A8 corridor seems to have improved bus reliability while the conventional corridor did not show any obvious changes in reliability over the same period.

Reliability: 2.5.4

From information collected from the ticket machines on buses it was possible to analysis journey times for bus services. Bus services along the A8 Greenway were compared to the A7/A701 conventional bus lane. A sample of approximately 1000 bus journeys, were taken for each bus lane in each direction. An analysis of how bus services complied with the times scheduled for them was done for both the Greenway and the conventional bus lane to see how each type of bus lane contributes to the reliability of bus services. The A8 Greenway was found to have a clear improvement in compliance with scheduled times during both the AM peak inbound and the PM peak outbound. However, the A7/A701 conventional bus lane did not show any improvement over the period of the study. This may be due to the fact it was unaffected by the Greenways and it also supports the theory that the improvement in reliability of bus services on the A8 was due to the introduction of the Greenway. The only negative to this analysis, is that there is no proof that the improvements made in the reliability of services would not have been made with conventional bus lanes.

Enforcement and infringement: 2.5.5

As mention in the introduction, Greenways are constantly patrolled between 7.30am - 6.30pm by 35 Traffic Wardens and 5 supervisors on any one day while conventional lanes only receive 'visits' commencing after 8.00 am by parking attendants. The amount of parking tickets received per kilometre of shop frontage for each of bus lanes were compared, the two Greenways had similar results which may be due to the fact the have the same level of enforcement while the conventional bus lane received more parking tickets per kilometre of shop frontage.

Regular bus users undertook a survey of both moving and parking infringement on the bus lanes being surveyed. It was found that the A8 Greenway had the highest level of moving infringements per kilometre of trip while the highest level of parking infringements was recorded on the conventional bus lane. The higher level of parking infringement on the conventional bus lane may have resulted in decreasing the moving infringements on the lane by discouraging car drivers from entering the lane.

Bus use: 2.5.6

Surveys conducted on 600 bus passengers showed that there had been an increase in bus use. Of the bus passengers surveyed 11% claimed to use the bus more in the two years since Greenways were introduced while 7% of those surveyed claimed to use the bus less. As a result there is a 4% increase in bus use which supports data collected from ticket machines showing an increase in bus use.

Possible amendments to improve Greenways: 2.5.7

The design of Greenways could be improved by avoiding carrying them on straight through junctions, by avoiding starting Greenways immediately after junctions as this can prevent car drivers using the inside lane thereby reducing capacity; and by avoiding unnecessarily reducing the queuing space available and therefore increasing queue frequency resulting in a greater level of congestion. This can be seen especially at the start of the Greenways where upstream buses have no priority and as a result get caught in the congestion.

Conclusions: 2.5.8

This study of Greenways and conventional bus priority lanes has shown that Greenways have a definite advantage in performance over conventional bus lanes. Journey time, reliability, and enforcement are all improved when Greenways are used. The success of Greenways can be attributed to its strict enforcement and the reduction in infringement on Greenways in comparison to conventional bus lanes. However, the attitude of car driver is more negative towards greenways as it reduces the capacity for cars causing congestion. It should be noted that car drivers attitude to conventional bus lanes is the same as it creates the same issues. Bus drivers were very positive about the introduction of Greenways with the entire sample stating that Greenways provided the fastest journey. The Greenway scheme in Edinburgh was found to be reasonably successful and as a result it has been extended to other routes throughout the city.

One of the main disadvantages of this study is that it only looks at the affect of coloured surfacing in a very limited way and the study of infringement on the lanes relies on the accuracy of bus user's observations who are not impartial observers.

Case study done as part of: (Scottish Executive CRU, 1999)

Chapter 3
Methods of study

Introduction: 3.1

This study was divided into three parts as follows:

- A number of areas throughout Edinburgh city were chosen to have observations carried out on them to see how car drivers complied with coloured cycle and bus lanes in comparison to uncoloured cycle and bus lanes.

- A questionnaire for cyclists was designed to ascertain their views and attitudes to having coloured and uncoloured cycle and bus lanes and identify the perceived differences in having coloured lanes over uncoloured lanes from the point of view of a cyclist.

- A questionnaire for car drivers was designed to ascertain their views and attitudes to having coloured and uncoloured cycle and bus lanes and identify the perceived differences in having coloured lanes over uncoloured lanes from the point of view of a car driver.

Observations: 3.2

The observations of the areas were carried out over a two and a half week period between the 30/01/2006 and the 16/02/2006. It was decided to conduct the surveys during peak traffic flows and as a result the surveys were conducted on week days during the morning rush hour of 8.00am to 9.00am at each location.

A total of 12 different observations were carried out, 3 for each type of lane, these are coloured cycle lanes and uncoloured cycle lanes, and coloured bus lanes and uncoloured bus lanes. The aim of the observations was to conduct an accurate traffic count of the cars travelling in the location being surveyed. An accurate count of all cars which encroached on the cycle or bus lane being surveyed was also conducted. This encroachment could was considered as being either fully or partially driving in the lane or being parked in the lane. Full encroachment was taken as a car driver driving in the lane while partial encroachment was taken as driving with only some of the car being in the lane.

There was some difficulty in choosing the locations to conduct the surveys due to the lack of uncoloured cycle and bus lanes in the central Edinburgh region where most of the surveys were carried out. Similar locations for coloured and uncoloured lanes were chosen so they could be paired together and compared to ensure the comparisons were accurate due to the similar attributes of the two locations being compared. An overall comparison of each type of location was also done to give a general picture of the advantages and disadvantages of each type of lane.

Cyclists Questionnaire: 3.3

An online was questionnaire was developed to collect the data needed to ascertain cyclist's views on the effects that coloured cycle and bus lanes had on car driver compliance with these lanes. A target sample size of 30 female and 30 male cyclists was set so comparisons between the two could be made. However the final sample size was 30 female and 70 male cyclists.

It was found that the difference in answers between male and female cyclists was negligible and as a result there was no need for comparison of results. It was also found that there was little or no difference given by the different age groups given in the questionnaire.

The questionnaires were sent out by email to a number of different groups which included students and staff at Napier University and number of different cycling clubs. The email clearly stated the purpose of the questionnaire and the issues that were being investigated. The questionnaire addressed a number of issues including the safety of different types of lanes, if the colouring of lanes would effect how often they would cycle and if they believed car drivers were more likely to comply with coloured lanes over uncoloured lanes.

Car Drivers Questionnaire: 3.4

The questionnaire of car drivers was also conducted online to ascertain their views and opinions on the effects of coloured surfacing on cycle and bus lanes. A target sample size of 60 was also set however, over 200 questionnaires were completed and analysed. It was found that there was little or no difference in the perception of male and female car drivers, and also car drivers of different ages in how they answered the questions.

The questionnaires were sent out by email to different groups within Edinburgh which included students and staff at Napier University and other random groups of car drivers within Edinburgh. This email clearly stated the purpose of the questionnaire and the issues that it dealt with. The questionnaire addressed a number of issues relating to how they as car drivers they complied with coloured cycle and bus lanes over those which are uncoloured and how they perceived other car drivers to comply.

Questionnaires method: 3.5

There are some disadvantages to this method of conducting questionnaires as firstly there may be a certain amount of bias in the responses as only car drivers and cyclists with access to the internet were surveyed. As a result of this the majority of people who answered the questionnaires were under the age of 45 and may not be typical of the average cyclist or car driver. Also it could be said that the majority of people who answered these questionnaires were avid cyclists or car drivers and may not be typical of the average cyclist or car driver.

Chapter 4
Results

Introduction: 4.1

This chapter will present results for the three areas of this study, firstly it will look at actual data that was achieved from observation of each different type of lane, this is followed by analysis of results from cyclist's questionnaires and the final area in this chapter will be the analysis of results from car driver's questionnaires.

Observations of study areas: 4.2

Observations of the following locations were completed.

(a) For coloured cycle lanes at: 4.2.1

- *Morrison Street* at the junction of Dalry Road and Maitland Street. This cycle lane is located between the turning traffic lane and the lane which goes straight and as a result of this there are some cars crossing it due to being in the wrong lane. The junction has traffic lights on it and has queue lengths of 6-12 cars. This side of the road has no shop frontage but this is not an important factor as the cycle lane is between two lanes of cars and there would be no parking as a result. The two lanes of traffic resulted in a high traffic count of 1024 cars. However, the level of cars encroaching (that is by either driving fully in the lane on partly in the lane) on the lane was small at 22 of this 8 fully encroached on the lane with the remaining 14 only partly encroaching on the lane. There were 48 cyclists that used this lane during the period of the observation.

- *Angle Park Terrace* at the junction of Henderson Terrace. This is a signalised junction with queue lengths of between 6 and 20 cars however these queues do not affect the level of encroachment on the lane. There are two shops but this did not result in cars being parked in the lane during the period of the survey. Over the period of the survey 588 cars were counted of which only 15 encroached on the lane, all of these encroachments were partial encroachments. There were 12 cyclists that used this lane during the period of the observation.

- *Teviot Place* at the junction of Forrest Road. There is a busy pedestrian crossing at this junction and therefore it resulted in queues of between 6-12 cars. There were no parked cars in the lane during the period of the survey. A traffic count resulted in a count of 709 cars, 28 of these encroached on the lane 10 of these were full encroachments while 18 were partial encroachments. There were 21 cyclists that used this lane during the period of the observation.

- *Bruntsfield Place* 40 metres from the pedestrian crossing at the junction of Leamington Terrace. This is the same location as that which is also listed under uncoloured cycle lanes as it was painted during the duration of the surveys and as a result another observation was carried out for comparison purposes. There is parking provided on the inside of the lane however there were no cars parked in it during the period of the survey. Queues at the junction varied from 5-10 cars which came back past the area being surveyed. A traffic count resulted in counting 530 cars, 26 of these encroached on the lane 9 of these were full encroachments while the remaining 17 were partial encroachments. There were 10 cyclists that used the lane during the period of the observation.

(b) For uncoloured cycle lanes at: 4.2.2

- *Bruntsfield Place* 40 metres from the pedestrian crossing at the junction of Leamington Terrace. There is parking provided on the inside of the lane however there were no cars parked in it during the period of the survey. Queues at the junction varied from 5-12 cars which came back past the area being surveyed. A traffic count resulted in counting 603 cars, 86 of these encroached on the lane 30 of these were full encroachments while the remaining 56 were partial encroachments. There were 7 cyclists that used the lane during the period of the observation.

- *Charlotte Square* 15 metres from the signalised junction of Charlotte Street. There is parking provided on the inside of the lane and there was cars parked there during the survey. There were 0-3 cars queuing at the lights at any one time. A traffic count resulted in counting 50 cars, 10 of these encroached on the lane 5 of these were full encroachments while the remaining 5 were partial encroachments. There were 10 cyclists that used the lane during the period of the observation.

- *Gilmerton Road* at the junction of Glennallen Drive. There are no lights at this junction and therefore there was no queuing. There are no shop fronts and as a result there were no parked cars. 203 cars passed during the period of the survey of which 14 encroached on the lane all of which were partial encroachments. There were 6 cyclists that used the lane during the period of the observation. Originally *Potterrow* had been chosen for this survey however due to construction work this location was no longer suitable.

(c) For coloured bus lanes at: 4.2.3

- *Lothian Road* at the junction of Morrison Street and Bread Street. This junction has lights and the entire road is shop fronts and as a result of this there were two cars parked in the lane each for a short period during the survey. There were queues of between 6 and 12 for the duration of the survey. A traffic count resulted in counting 723 cars, 8 of these encroached on the lane 4 of these were full encroachments while the remaining 4 were partial encroachments. There were 89 cyclists, 32 buses and 22 taxis that used this lane during the period of the observation.

- *North Bridge* on the bridge itself approximately 100 metres from the junction at Princes Street. There was 1 car parked at a premise at the end of the bridge. There were no queues at this location due to its distance from the junction. A traffic count resulted in counting 510 cars, 15 of these encroached on the lane 8 of these were full encroachment while the remaining 7 were partial encroachments. There were 40 cyclists, 80 buses and 8 taxis that used the lane during the period of the observation.

- *Shandwick Place* 10 metres from the pedestrian lights at the junction of Stafford Street. The entire road has shop fronts however there were no cars parked in it during the period of the survey. Queues varied from 4 to 7 cars in length. A traffic count resulted in counting 658 cars, 26 of these encroached on the lane 9 of these were full encroachments while the remaining 17 were partial encroachments. There were 21 cyclists, 128 buses and 13 taxis that used the lane during the period of the observation.

(d) For uncoloured bus lanes at: 4.2.4

- *George IV Bridge* 40 metres from the Victoria Street junction. There are no lights here however there are traffic lights at the junction a further 25 metres after the Victoria Street junction which results in overall queues of 12-20 cars. There are shops along this stretch of road however this did not result in cars parking in the lane. A traffic count resulted in counting 504 cars, 56 of these encroached on the lane 26 of these were full encroachments while the remaining 30 were partial encroachments. There were 73 cyclists, 25 buses and 18 taxis that used the lane during the period of the observation.

- *Brunton Place* at the junction of Brunton Terrace which is approximately 30 metres from a signalised junction as a result there were no queues past the point being surveyed. There were no cars parked in the lane during the duration of the survey. A traffic count resulted in counting 521 cars, 33 of these encroached on the lane 13 of these were full encroachments while the remaining 20 were partial encroachments. There were 11 cyclists, 59 buses and 8 taxis that used the lane during the period of the observation.

- *North Saint Andrew Street* to the lights at Andrew Square. This is a one way street with shops and offices on it however parking is provided on the inside of the lane and as a result there was no cars parked in it during the duration of the survey. Due to a low traffic flow queues varied from 0-3 cars. A traffic count resulted in counting 96 cars, 24 of these encroached on the lane 13 of these were full encroachments while the remaining 11 were partial encroachments. There were 12 cyclists, 91 buses and 18 taxis that used the lane during the period of the observation.

Comparisons of individual results: 4.3

Comparison of individual coloured and uncoloured cycle lanes: 4.3.1

As it is difficult to tell the difference between partial and full encroachment on cycle lanes, only overall levels of encroachment will be considered in this section. When comparing coloured and uncoloured cycle lanes, the following areas were chosen for comparison.

Bruntsfield Place verses Morrison Street: 4.3.1.1

The uncoloured cycle lane on Bruntsfield Place verses the coloured cycle lane on Morrison Street. These areas were chosen for comparison due to the similarity of the locations, both cycle lanes are not affected by parking as parking is provided on the inside of the cycle lane at Bruntsfield Place while there is no parking on Morrison Street. The locations have similar traffic flows as there was a traffic count of 603 for Bruntsfield Place while there was a traffic count of 1024 divided over two lanes on Morrison Street. Morrison Street had far more cyclists at 48 in comparison to the 7 on the Bruntsfield Place cycle lane, this lower number may be due to the fact that that it is and outbound lane in the morning rush hour. Bruntsfield Places uncoloured cycle lane had a level of 14% of all cars encroaching in comparison to 2% encroachment by cars on the coloured cycle lane at Morrison Street. The uncoloured lane at Bruntsfield Place can also be compared to itself as it was coloured during the period of the study, the main difference from the observation of the cycle lane on Bruntsfield Place when it was coloured is that there was a reduction in the level of encroachment by cars from 14% to 5% which corresponds to the results collected on Morrison Street.

Gilmerton Road versus Teviot Place: 4.3.1.2

The uncoloured cycle lane on Gilmerton Road versus the coloured cycle lane on Teviot Place. These lanes were chosen for comparison as the both have good pedestrian facilities and neither

lane was parked on during the duration of the survey. However, Teviot Place had a much higher traffic count of 709 in comparison to 203 on the Gilmerton Road over the observation periods. Gilmerton Roads uncoloured cycle lane had a level of 7% of all cars encroaching in comparison to 4% encroachment by cars on the coloured cycle lane at Teviot Place.

Charlotte Square versus Angle Park Terrace: 4.3.1.3

The uncoloured cycle lane on Charlotte Square versus the coloured cycle lane on Angle Park Terrace. These lanes were chosen for comparison due to the fact that they have a similar level of use by cyclists. However, Angle Park Terrace had a much higher traffic count of 588 in comparison to just 50 on the Charlotte Square over the observation periods. Charlotte Squares uncoloured cycle lane had a level of 20% of all cars encroaching in comparison to just 2.5% encroachment by cars on the coloured cycle lane at Angle Park Terrace.

Comparison of individual coloured and uncoloured bus lanes: 4.3.2

When comparing coloured and uncoloured bus lanes, the following areas were chosen for comparison.

George IV Bridge versus Lothian Road 4.3.2.1

The uncoloured bus lane on George IV Bridge versus the coloured bus lane on Lothian Road. These lanes were chosen for comparison as they have a similar traffic flow with George IV Bridge having a traffic count of 504 cars in comparison to Lothian Roads traffic count of 723 cars. The bus lanes also have a similar number of buses, cyclists and taxis using them with the uncoloured bus lane on George IV Bridge having 25 buses 73 cyclists and 18 taxis using it in comparison to the Greenway on Lothian Road which had 32 buses 89 cyclists and 22 taxis using in over the observation period. Queue lengths for both lanes were similar with the queues on George IV Bridge being slightly longer. George IV Bridges uncoloured bus lane had a level of 11% of all cars encroaching in comparison to just 1% encroachment by cars on the Greenway at Lothian Road. Of the encroachments by cars on the George IV Bridge uncoloured bus lane 5% were driving entirely in the lane with the remaining 6% driving partially in the lane while the 1% of encroachment by cars on the Greenway at Lothian Road was divided evenly between cars driving fully in the lane and cars partially driving in the lane.

North Saint Andrews Street versus Shandwick Place: 4.3.2.2

The uncoloured bus lane on North Saint Andrews Street versus the coloured bus lane on Shandwick Place. These bus lanes were chosen for comparison as the bus lanes have a similar number of buses, cyclists and taxis using them with the uncoloured bus lane on North Saint Andrews Street having 91 buses 12 cyclists and 18 taxis using it in comparison to the Greenway on Shandwick Place which has 128 buses 21 cyclists and 13 taxis using in over the observation period. However, there was a large difference in the traffic counts for the two locations with Shandwick Place having a traffic count of 658 cars in comparison to North Saint Andrews Street having a traffic count of only 96 cars. Queue lengths for both lanes were small with the Shandwick Place queue being slightly longer due to its higher traffic flow. North Saint Andrews Streets uncoloured bus lane had a level of 25% of all cars encroaching in comparison to just 4% encroachment by cars on the Greenway at Shandwick Place. Of the encroachments by cars on the North Saint Andrews Street uncoloured bus lane 14% were driving entirely in the lane with the remaining 11% driving partially in the lane while the 4% of encroachment by cars on the Greenway at Shandwick Place 1% were driving entirely in the lane with the remaining 3% driving partially in the lane.

Brunton Place versus North Bridge: 4.3.2.3

The uncoloured bus lane on Brunton Place versus the coloured bus lane on North Bridge. These lanes were chosen for comparison as they have a similar traffic flow with Brunton Place having a traffic count of 521 cars in comparison to North Bridges traffic count of 510 cars. The bus lanes also have a reasonably similar number of buses, cyclists and taxis using them with the uncoloured bus lane on Brunton Place having 59 buses 11 cyclists and 8 taxis using it in comparison to the Greenway on North Bridge which has 80 buses 40 cyclists and 8 taxis using in over the observation period. There were no queues for either lane due to the fact that both locations for the observations were a considerable distance from any signalised junctions. Brunton Places uncoloured bus lane had a level of 6% of all cars encroaching in comparison to just 3% encroachment by cars on the Greenway at North Bridge. Of the encroachments by cars on the Brunton Place uncoloured bus lane 2% were driving entirely in the lane with the remaining 4% driving partially in the lane while the 3% of encroachment by cars on the Greenway at North Bridge was divided evenly between cars driving fully in the lane and cars partially driving in the lane.

Comparisons of mean results: 4.4

Each different type of area is graphically represented below in terms of the average results of the percentage of cars that do not drive in the lane being surveyed versus the percentages of cars either driving fully in the lane or partly in the lane.

Fig 4.1

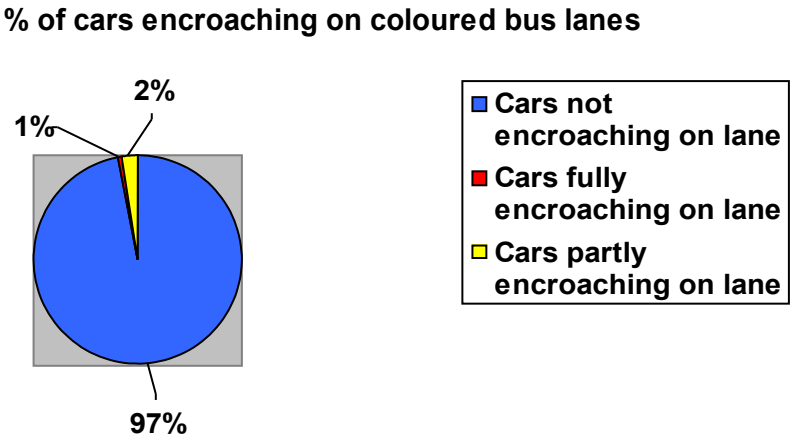
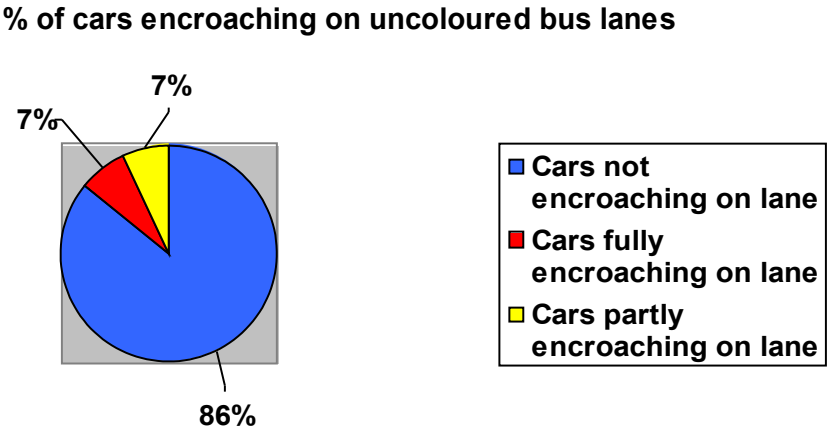


Fig 4.2



Three different areas have been surveyed for both coloured and uncoloured bus lanes and although there are some differences in the areas being surveyed such as road width, distance from traffic lights, volume of traffic, length of queues and whether there was cars parked in the lane, the areas chosen were picked for their similarity which is sufficient to make them suitable for comparison.

Fig 4.3

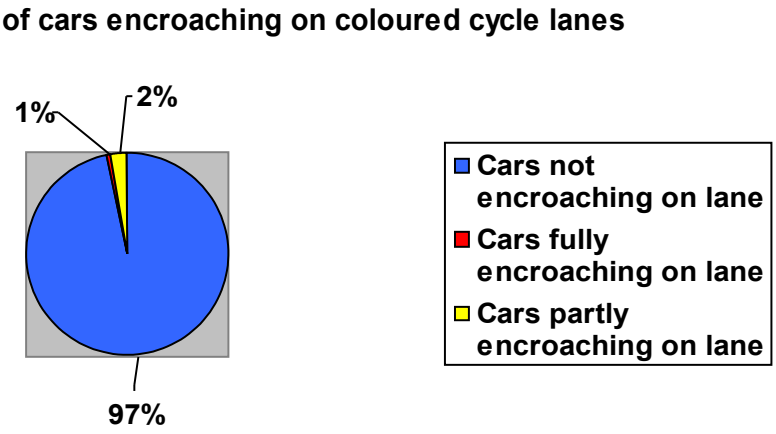
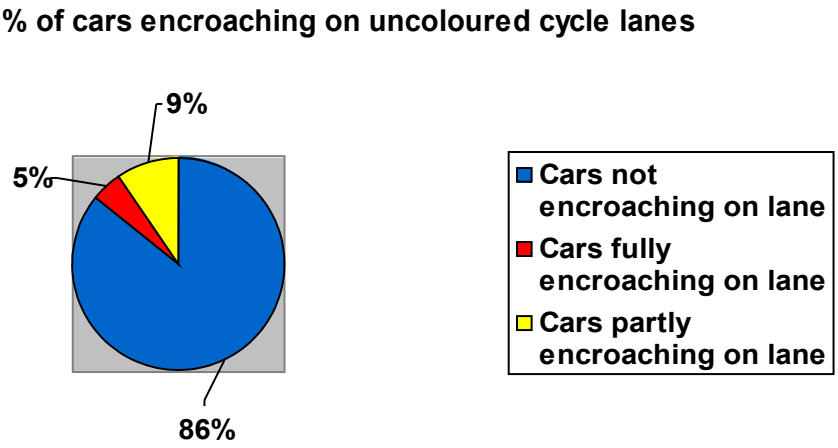


Fig 4.4



Four areas have were surveyed for the coloured cycle lanes and three areas for the uncoloured cycle lanes and although there are some differences in the areas being surveyed such as road width, distance from traffic lights, volume of traffic, length of queues and whether there was cars parked in the lane, the areas have a good similarity which makes the suitable for comparison. However, the cycle lane at *Bruntsfield Place* was surveyed twice once when it was an uncoloured cycle lane and once when it was a coloured cycle lane. The results correspond to the to the average results which has been graphed by showing a major increase in the car driver compliance with the cycle lane when it was coloured over when it was uncoloured, this seems to prove the validity of these averaged survey results even though there was some differences in the areas being surveyed.

Statistical significance of mean results: 4.4.1

A t-test was conducted for both uncoloured and coloured cycle and bus lanes to determine the statistical significance of the mean results which have been calculated.

Statistical significance of coloured versus uncoloured cycle lanes: 4.4.1.1

Variable 1, Uncoloured cycle lanes	Variable 2, Coloured cycle lanes
14	2
7	4
20	2.5

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	13.66666667	2.833333333
Variance	42.33333333	1.083333333
Observations	3	3
Pearson Correlation	-0.750630666	
Hypothesized Mean Difference	0	
df	2	
t Stat	2.563349772	
P(T<=t) one-tail	0.062207663	
t Critical one-tail	2.91998558	
P(T<=t) two-tail	0.124415326	
t Critical two-tail	4.30265273	

The data in this table shows that the results are not statistically significant as the result for 'P(T<=t) two-tail' is greater than 0.05 and also there is reasonably small t Stat value.

Statistical significance of coloured versus uncoloured bus lanes: 4.4.1.2

Variable 1, Uncoloured bus lanes	Variable 2, Coloured bus lanes
11	1
25	4
6	3

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	14	2.666666667
Variance	97	2.333333333
Observations	3	3
Pearson Correlation	0.56499508	
Hypothesized Mean Difference	0	
df	2	
t Stat	2.163368194	
P(T<=t) one-tail	0.081488931	
t Critical one-tail	2.91998558	
P(T<=t) two-tail	0.162977861	
t Critical two-tail	4.30265273	

The data in this table also shows that the results are not statistically significant as the result for 'P(T<=t) two-tail' is greater than 0.05 and also there is reasonably small t Stat value.

The author believes that the reason that the results are not statistically significant is as a result of the small variable size and as a result a t-Test for a combination of both cycle and bus lanes has been compiled.

Statistical significance of coloured versus uncoloured lanes: 4.4.1.3

Variable 1, Uncoloured lanes	Variable 2, Coloured cycle lanes
14	2
7	4
20	2.5
11	1
25	4
6	3

t-Test: Paired Two Sample for Means

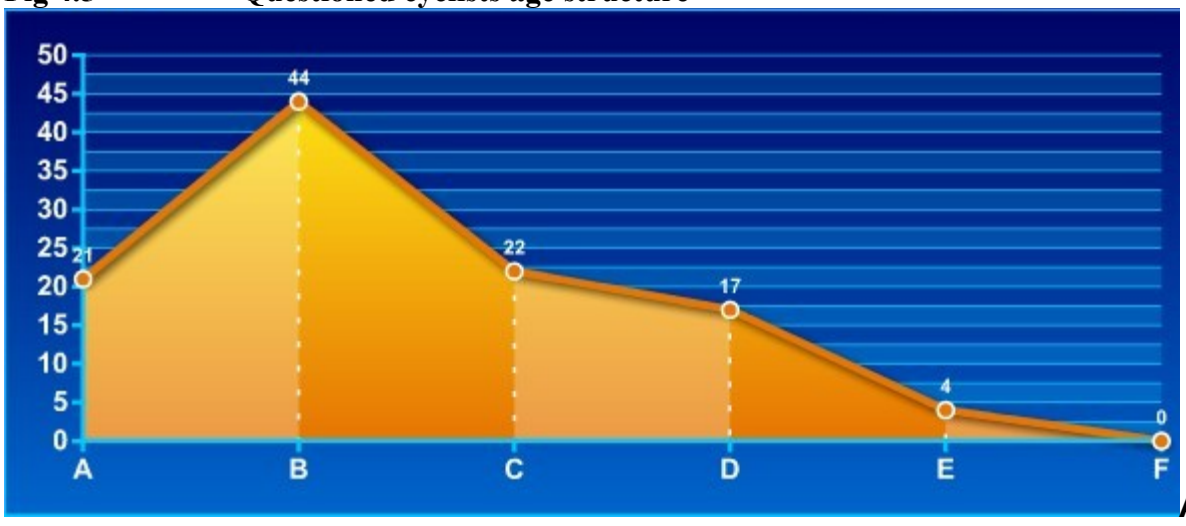
	Variable 1	*Variable 2*
Mean	13.83333333	2.75
Variance	55.76666667	1.375
Observations	6	6
Pearson Correlation	0.154168297	
Hypothesized Mean Difference	0	
df	5	
t Stat	3.679428043	
P(T<=t) one-tail	0.007151064	
t Critical one-tail	2.015048372	
P(T<=t) two-tail	0.014302128	
t Critical two-tail	2.570581835	

When the results for both cycle and bus lanes are combined the results become statistically significant as the result for 'P(T<=t) two-tail' is less than 0.05 and also there is a larger t Stat value.

Cycling Questionnaire Analysis: 4.5

Over 100 people took part in the questionnaire for cyclists however only 30 of these were female cyclists. The age structure of these cyclists is shown in the chart below.

Fig 4.5 Questioned cyclists age structure



A) 18-25 B) 26-35 C) 36-45 D) 46-55 E) 56-65 F)>65

The majority of people who filled out questionnaires were regular cyclists, the average female cyclist cycled in Edinburgh four days a week while the average male cyclist cycled in Edinburgh five days a week.

The questionnaire asked cyclists to rate five different conditions to cycle in from 1-5 with 1 being the safest condition and 5 being the least safe condition.

The vast majority (62%) of people surveyed rated the ordinary road without cycle or bus lanes with a rating of 5 being the most dangerous of the conditions to be rated. As a result of this, this type of road is viewed the least safe type of condition to cycle in by cyclists with an average score of 4.13 out of five.

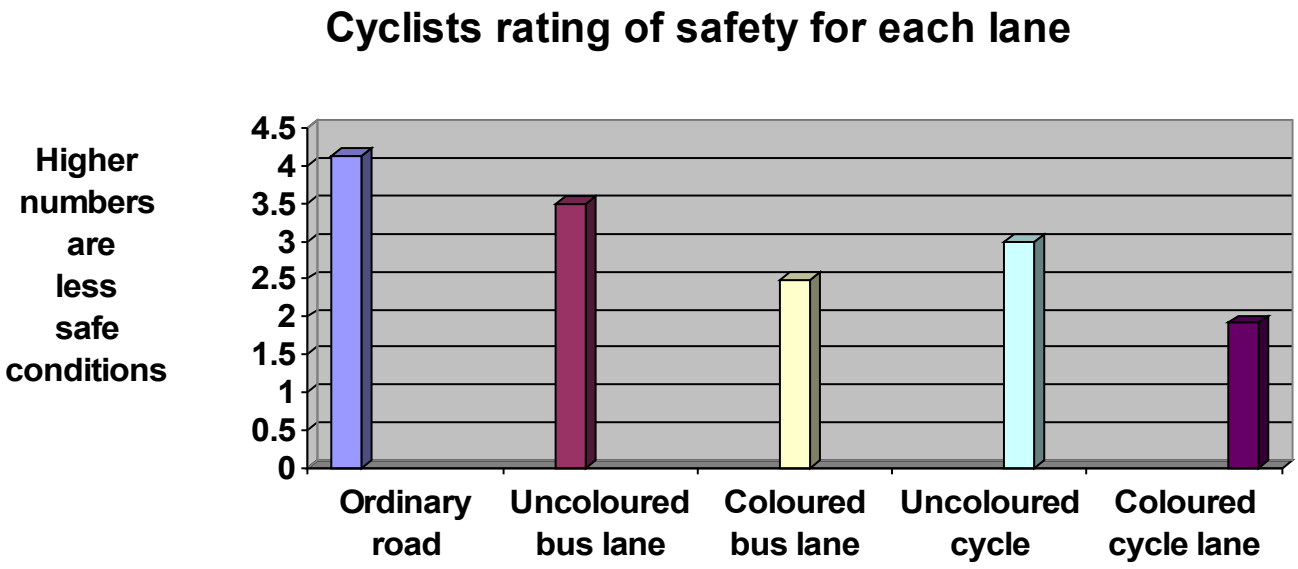
The majority (49%) of people surveyed rated the uncoloured bus lane at 4 as being the second most dangerous condition. As a result of this, this type of road is viewed the second least safe type of condition to cycle in by cyclists with an average score of 3.49 out of five.

Coloured bus lanes did not have a clear majority in how people rated it 28% of people gave it the safest rating of 1, 20% of people gave it the second safest rating of 2 while the largest majority of 33% of people gave it a rating of 3. Although the majority of cyclists gave this condition a rating of 3, it achieved an average score of 2.48 out of five resulting in it being considered the second safest condition to cycle in.

Uncoloured cycle lanes did have a clear majority of 40% giving it a rating of 2 however it also had 24% of people giving it a rating of 3 and an additional 21% of people giving it a rating of 4. Although the majority of cyclists gave this condition a rating of 2, it achieved an average score of 2.96 out of five resulting in it coming in as the third safest of the conditions to cycle in.

A large majority of 57% of people gave coloured cycle lanes the safest rating of 1. As a result of this, this type of road is viewed the safest type of condition to cycle in by cyclists with an average score of 1.92 out of five.

Fig 4.6



When cyclists were asked would they cycle more frequently if all cycle lanes were coloured the majority said this would not affect the amount of times they cycled however a large number of these cyclists commented on the fact that they believed there was an advantage in having cycle lanes and that the preferred coloured cycle lanes.

The same was true when cyclist were asked would they cycle more frequently if all bus lanes were coloured the majority also said this would not affect the amount of times they cycled although they did believe there was an advantage in having coloured bus lanes.

Cyclists were asked did they feel car drives are more likely to comply with coloured cycle and bus lane over uncoloured cycle and bus lanes and 90% of cyclists said they believed that car drivers were more likely to comply with coloured lanes over uncoloured lanes. Many cyclists also commented on the fact that the biggest issue for them was not the driving of cars in cycle lanes but the parking of cars in the cycle lane which forced cyclists back into the normal traffic lane which increased the risk of them being knocked down by car drivers.

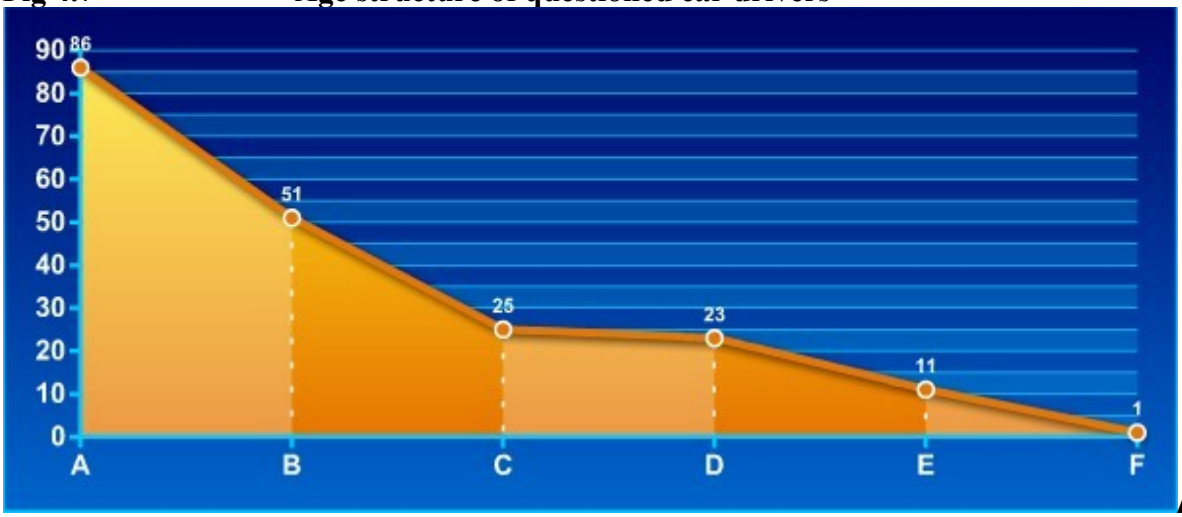
Conclusions: 4.5.1

From the results of the cyclist's questionnaires, on the effects of coloured surfacing on car driver compliance with cycle and bus lanes it is clear that cyclists believe that there is an advantage in having coloured lanes over uncoloured lanes. The biggest issue for cyclists was the safety of the conditions the cycled in. A number of cyclists commented on the fact that completely segregated cycle paths were the safest and would encourage them to cycle more. However, segregated cycle paths are not always viable options and also they were outside the remit of this study.

Car drivers Questionnaire Analysis: 4.6

Almost 200 people took part in the questionnaire for car drivers with almost a 50:50 split in male and female drivers. The age structure of these drivers is shown in the chart below.

Fig 4.7 Age structure of questioned car drivers

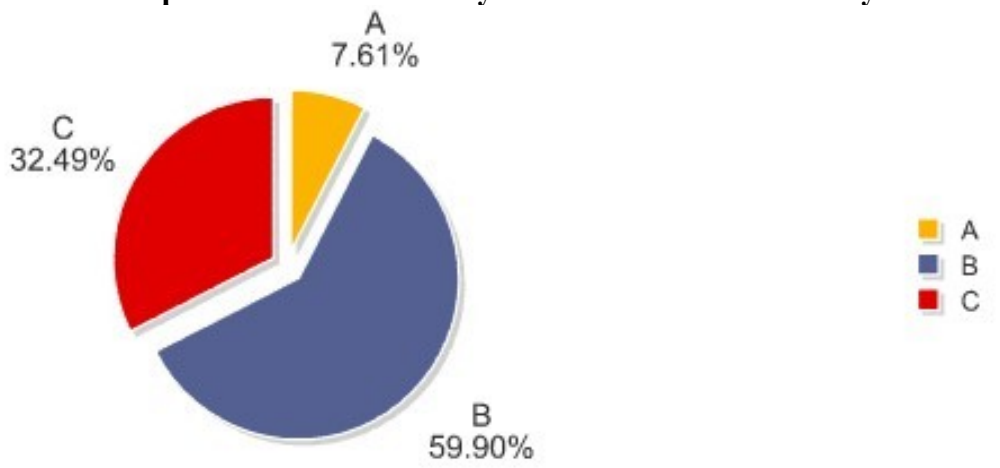


A) 18-25 B) 26-35 C) 36-45 D) 46-55 E) 56-65 F) >65

The majority of people who filled out questionnaires regularly drove in Edinburgh with both female and male drivers driving in Edinburgh between four and five days a week.

When car drivers were asked were they more or less likely to comply with a cycle lanes that is coloured over those that are uncoloured. The following results were recorded.

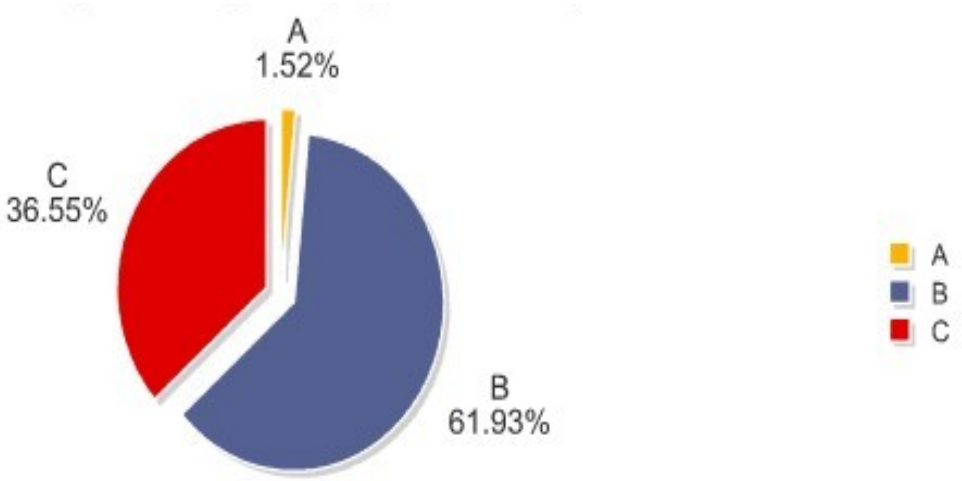
Fig 4.8
Car driver compliance with coloured cycle lanes over uncoloured cycle lanes



A) More likely **B) Less likely** **C) No difference**

When car drivers were asked were they more or less likely to comply with Greenways over uncoloured conventional bus lanes. The following results were recorded.

Fig 4.9
Car driver compliance with coloured bus lanes over uncoloured bus lanes



A) More likely **B) Less likely** **C) No difference**

When car drivers were asked how often they drove or parked in bus lanes when not permitted to do so, the following data was recorded.

For Greenways 3% of car drivers admitted not complying daily, 10% admitted not complying weekly, 14% admitted not complying monthly while 73% of car drivers said they always complied with Greenways.

For uncoloured bus lanes 4% of car drivers admitted not complying daily, 17% admitted not complying weekly, 14% admitted not complying monthly while 65% of car drivers said they always complied with uncoloured bus lanes.

When car drivers were then asked did they think other car drivers drove in bus lanes when not permitted to do so, the vast majority of all drivers said they regularly noticed other car drivers in bus lanes. Many of those questioned commented on the fact that encroachment on bus lanes was especially prevalent if there was a left turn ahead and drivers could skip the queue by driving in the bus lane.

When car drivers were asked how often they drove or parked in cycle lanes the following data was recorded.

For coloured cycle lanes 4% of car drivers admitted not complying daily, 12% admitted not complying weekly, 18% admitted not complying monthly while 66% of car drivers said they always complied with coloured cycle lanes.
For uncoloured cycle lanes 3% of car drivers admitted not complying daily, 19% admitted not complying weekly, 16% admitted not complying monthly while 62% of car drivers said they always complied with uncoloured cycle lanes.

When car drivers were then asked did they see other car drivers driving in cycle lanes, a small majority of all drivers said they regularly noticed other car drivers in cycle lanes. However a significant number of car drivers said they rarely or never noticed other car drivers driving or parked in cycle lanes.

Conclusions: 4.6.1

It was clear from some of the comments of car drivers that they were hostile to the idea of cycle lanes and especially bus lanes as they believe that they add to congestion within the city. However, the vast majority of car drivers admitted that they were more likely to comply with coloured cycle and bus lane over those that were uncoloured. As a result it could be said there is a distinct advantage in having coloured lanes over uncoloured lanes.

Chapter 5
Conclusions and Recommendations

Conclusions: 5.1

Effectiveness of colouring cycle and bus lanes: 5.1.1

This study clearly indicates that there is an advantage in having coloured cycle and bus lanes. The observations carried out show that for both cycle and bus lanes that fewer cars drove in the coloured lanes than the uncoloured lanes. Interestingly it was found that on average 3% of cars drove in both coloured cycle lanes and coloured bus lanes. Also it was found that on average of 14% of cars drove in both uncoloured cycle lanes and uncoloured bus lanes. This would seem to indicate that there is some correlation in how car drivers rate the significance of a coloured lane in comparison to an uncoloured lane. It seems from the above data that car drivers believe that coloured lanes are more important than uncoloured lanes and therefore they are more likely to comply with them than uncoloured lanes.

From the car driver's questionnaire approximately 60% of drivers said that they were more likely to comply with a coloured cycle or bus lane than an uncoloured cycle or bus lane. This figure would also support the theory that car drivers believe coloured lanes to be of higher importance than uncoloured lanes.

From the cyclist's questionnaire cyclists said that the frequency with which they cycled would not be affected by whether cycle and bus lanes were coloured or uncoloured. From this information the effectiveness of coloured lanes in attracting people to cycle more could be questioned. However, it should be stated that vast majority of cyclists questioned were already regular cyclists and that this questionnaire does not consider new cyclists who might be attracted to cycle because of the colouring of cycle and bus lanes.

Safety: 5.1.2

Safety is one of the greatest concerns for cyclists when they cycle on roads that they share with general traffic. From the cyclists questionnaires carried out it was found the that majority of cyclists supported the concept of colouring lanes as they believed that coloured lanes were safer to cycle in than uncoloured lanes due to the fact that car drivers were more likely to comply with them than uncoloured lanes.

Edinburgh's Local Transport Strategy: 5.1.3

It is one of the main aims of Edinburgh City Council to reduce the level of congestion within the city. To achieve this there needs to be a reduction in car use while having an increase in bus use and the uptake of cycling. The introduction of Greenways and coloured cycle lanes are seen by the council as ways that the council can encourage an increase in bus use and cycling.

As part of the case study detailed in the literature review a number of regular bus users surveyed the levels of both moving and parking infringements on a Greenway and on a conventional bus lane so they could be compared. This survey found that the level of moving infringements on the Greenway was greater than that on the conventional bus lane, while the level of parking infringements was greater on the conventional bus lane than the Greenway. The higher level of moving infringements recorded in the case study directly contradicts the studies of Greenways conducted in this report which showed that there was a lower level moving infringements on Greenways than on conventional uncoloured bus lanes. The explanation for this may be that for the case study there was a higher level of parking infringement for the conventional bus lane than the Greenway which may have discouraged car drivers from driving in the conventional bus

lane. However, in the study carried out in this report moving infringements were not affected by parking infringements and therefore could be considered to be a more accurate representation of the actual levels of moving infringements on both Greenways and conventional uncoloured bus lanes.

Objectives Achieved: 5.1.4

The four objectives set out for this study were clearly defined and as a result they have been achieved.

(1) It was found from the observations that car drivers are much more likely to comply with coloured cycle and bus lanes than uncoloured cycle and bus lanes.

(2) From cyclists questionnaires it was found that they believe safety to be the most significant issue and they find coloured lanes to be safer than uncoloured lanes.

(3) From the car drivers questionnaires it was found that the colouring of lanes has some effect on whether they will comply with that lane or not, with the majority of drivers admitting they are more likely to comply with coloured lanes.

(4) The policies of Edinburgh City Council with regard to the colouring of cycle and bus lanes was looked at and it was found that though there has been significant improvement in the network of cycle and bus lanes throughout Edinburgh there is a lack of research into car driver compliance with coloured lanes over uncoloured lanes.

Recommendations: 5.2

Recommended work for the council: 5.2.1

The author feels that the colouring of all remaining uncoloured cycle and bus lanes should remain a priority for the council due to the benefits for buses in their reliability and journey times and for cyclists due to the fact that it creates a safer environment for cycling.

Future studies to carry out 5.2.2

The author believes that while this study gives a detailed report on the effects of moving infringements on cycle and bus lanes, it was unable to consider the all effects that parking infringements have on cycle and bus lanes due to the fact that the observations carried out between 8.00am and 9.00am, when there were no cars parked in the cycle or bus lanes. If further work in this area was to be carried out the author would recommend that additional observations be carried out throughout the day on a number of coloured and uncoloured cycle and bus lanes, to consider the effects coloured surfacing has on parking infringements and the effect that parking infringements has on buses and cyclists.

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APPENDIX 1

Cyclists Questionnaire

This questionnaire is to help find out if there is an advantage for cyclists in having coloured cycle lanes and Greenways over uncoloured cycle lanes throughout the city of Edinburgh.

1. Your sex? Male ☐ Female ☐

2. Your age? 18-25 ☐ 26-35 ☐ 36-45 ☐ 46-55 ☐ 56-65 ☐ >65 ☐

3. How often do you cycle in Edinburgh city?

Often *number of times a month* ☐ Sometimes *number of times a year* ☐ Occasionally *number of times a week* ☐

4. Please allocate a number from 1-5 for each type of condition with 1 being the safest condition and 5 being the least safe condition?

- Ordinary road without cycle lanes ☐
- Uncoloured bus lanes ☐
- Coloured bus lanes ☐
- Uncoloured cycle lanes ☐
- Coloured cycle lanes ☐

5. Would you cycle more frequently if?

- All cycle lanes coloured ☐
- All cycle lanes were not coloured ☐
- There were no cycle lanes ☐
- None of above ☐

6. Would you cycle more frequently if?

- All bus lanes were coloured ☐
- All bus lanes were not coloured ☐
- There were no bus lanes ☐
- None of above ☐

7. Do you feel car drives are more likely to comply with coloured cycle and bus lane over uncoloured cycle and bus lanes?
Note: cycle lanes are only the lane and do not include advanced stop lines.

Yes ☐ No ☐

Thank you for taking the time to complete this Questionnaire