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Dublin Cyclist’s Risk Behaviour:

Comparison of Observed

and Reported Behaviour,

Cyclist level, Personality and Gender

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Dublin cyclist's risk behaviour: Comparison of observed and reported behaviour, cyclist level, personality and gender.
Abstract

A comprehensive analysis using naturalistic observation and self report methods was undertaken to provide a better representation of Dublin cyclist’s risk behaviour. Through multi stage sampling 544 cyclists were observed at 4 locations across Dublin City. A self report questionnaire including the big five inventory, Adolescent Cyclist Behaviour Questionnaire (ACBQ) and a perceived risk questionnaire was completed by 175 cyclists. Observational research found red light breaking and helmet use was higher than previous research suggested. No significant relationship between ACBQ scoring and cyclist level, neuroticism scoring or gender was found. The perceived risk of cycling in Dublin is lower than previously reported. Cyclists view their own behaviour as less risky than other cyclists. Risk behaviour tendencies may be domain specific.
Introduction
General Introduction

Cycling has witnessed a dramatic rise in popularity since 2006, a year in which cycling figures reached their lowest point since 1986 (Doherty, 2008). The 2012 ‘Canal Cordon’ cyclist survey conducted by Dublin City Council revealed that the number of cyclists entering Dublin City has increased by 45% since 2006 (Gormley, 2012). There was a 16% rise in the number of cyclists in Dublin City during 2012 alone (Allen, 2013).

Several factors are responsible for this increase. Greater interest in professional racing, due in part to the recent Tour de France success of the British cycling team, Team Sky, the inclusion of three Irish cyclists in the top professional ranks, and the diary-form insight into professional racing provided by Irish professional cyclist Nicolas Roche in the Irish Independent and more recently Dan Martin in the Irish Times each summer has increased public awareness of professional cycling and improved cycling’s image as an attractive sport to the general public.

The establishment of a comprehensive sportive calendar of charity and non charity cycling events catering for all levels of leisure cyclists has made cycling an appealing sport for people of all ages to pursue, with the registration figures for the most popular irish sportive, the Ring of Kerry charity cycle, increasing by 60% in 2011 alone (Hughes, 2012).

Increased participation in amateur competition has seen Cycling Ireland membership rise from 5,000 to just under 14,000 since 2008, with an increase of approximately 2,000 members from 2011 to 2012 alone (Cycling Ireland Figures, 2012). The government initiative of the ‘Bike to Work’ scheme, established in 2009, has had a major influence on bike sales with over 9,000 bikes purchased using the scheme to date (Croffey, 2012).
The National Cycling Policy Framework 2009-2020 (Department of Transport, 2009) which was implemented to instil a cycling culture in Ireland, aiming to increase the bicycle commuter percentage from 1.9% in 2008 to 10% by 2020 through traffic flow and bicycle specific infrastructural improvements, has also played a role in the increased number of commuter cyclists on Dublin roads today (Murphy, 2013).

Despite the increase in cycling popularity and cycling figures in Ireland, the perception of cycling as a high risk form of transport is a regional and global barrier to higher cycling take up, especially in Dublin. Perceptions of risk or the likelihood that an individual will experience a danger are influenced by both the probability of an adverse event (e.g. the risk of a crash) and the magnitude of the consequences (e.g. the severity of the injury). Research shows that people are reluctant to take up cycling in Dublin due to safety concerns (Lawson, Pakrashi, Ghosh & O’Brien, 2011). This perception is inconsistent with Dublin cycling accident and fatality rates; while cycling activity in Dublin has significantly increased, up 29% since 2006 (Croffey, 2012), cyclist fatalities in Dublin are down 83% since 2006, with a single fatality recorded each year for the past three years ("Dublin cyclist deaths," 2012)

Cyclist fatalities across Ireland have also been declining, with a 66% percent drop in cyclist fatalities in Ireland between 2007 and 2010. The percentage of cyclists killed on Irish roads in relation to total road deaths remained consistent at 3.5% between 1998 and 2010, which is below the EU average of 6.8% for 2008 (Candappa, Christoph, Vis, & Kirk, 2011). Recent European cyclist research conducted in England and the Netherlands suggests that the fatality rate per kilometre travelled is higher for motorists than for cyclists, with cyclist’s safety ranking on par with pedestrians (Farrelly, 2012).
Further analysis of age and gender fatality rates suggest it is safer for young males to cycle than it is to travel by car (Mindell, Leslie & Wardlaw, 2012). Yet the risk perception of Dublin cyclists is in contrast to these statistics, as it is cyclists below the age of twenty-four who feel most at risk on the roads (Lawson, Pakrashi, Ghosh & O’Brien, 2011).

This brief review of Irish cycling trends and statistics highlights the need for relevant research into the risk behaviour tendencies and perceptions of cyclists, to better facilitate an increase in cycling safety in Dublin and a decrease in road accident and fatalities.
Main Theories and Research

Social cognitive theories help explain the link between risk perception and risk behaviour. The health belief model developed by Rosenstock (1966, as cited in Passer, Smith, Holt, Bremner, Sutherland & Vliek, 2009) and further developed by Becker (1970;1980, as cited in Passer et al, 2009) is a psychological model of health behaviour examining the role of knowledge and perceptions in personal responsibility. It suggests that an individual’s belief in a threat combined with their belief in the effectiveness of the proposed behaviour predicts an individual’s behavioural tendency. It details three main processes; risk assessment, perceived seriousness and consequence of behaviour, and the perceived barriers/influences to that behaviour.

Although important to the understanding of the social-cognitive risk evaluation process, it’s limitations have been demonstrated by Icek Ajzen’s Theory of Planned Behaviour (TPB) (1985). Self report questionnaire research examining helmet use of school-boy cyclists suggests the additional factor of intention which is not encompassed in the health belief model is an influential variable in an individual’s risk behaviour evaluation process (Quine, Rutter & Arnold, 1998).

The TPB and the preceding theory of reasoned action put forth by Ajzen and Fishbein (1980), focused on the argument that attitude predicts behaviour, with the relationship between attitude and behaviour varying depending on several factors. This theory has been supported in recent cyclist safety research which revealed that cyclist’s who do not wear helmets are more likely to perform other risk behaviours while cycling (Bambach, Mitchell, Grzebieta & Olivier, 2013).
Attitude influences behaviour more strongly when situational factors that contradict our attitudes are weak, when we are aware of our attitudes and acknowledge our resolve towards them, and in specific and general schemas (Passer et al, 2009). General attitudes relate more strongly to general behavioural tendencies, with specific attitudes relating more strongly to specific behavioural tendencies. (Fazio & Roskos-Ewoldsen, 2005). The TPB suggests our intention to engage in a behaviour is strongest when we have a positive attitude towards that behaviour, when subjective norms (peer perception and their attitudes) reinforce our beliefs, and we feel in control of our own behaviour (Passer et al, 2009).

Research based on this theory has successfully predicted traffic risk behaviour tendencies, including helmet use in adolescent cyclists (Quine, Rutter & Arnold, 1998), helmet use in relation to distance travelled (Deegan, 2011) and motorist risk behaviour such as speeding, drink driving and seat belt wearing (Gordon & Hunt, 1998).

There is limited published research of cyclist’s attitudes and subsequent risk behaviour. Research in Australia in relation to red light breaking suggests that cyclists are more likely to break a red light when turning left as their attitude towards this behaviour is not as negative compared to breaking a red light while continuing straight or turning right (Johnson, Newstead, Charlton & Oxley, 2011).

While the TPB is an important theory in understanding risk, the exclusion of descriptive norms as an influential factor for risk behaviour analysis is significant, in particular to understanding cycling risk behaviour. Descriptive norms relate to the perception of individuals of what is commonly done in specific situations, irregardless of cultural or societal expectations, and may be an important variable in understanding cyclist’s risk behaviour, in particular their attitude towards red light breaking and helmet use (Rivis & Sheeran, 2003).
Criticisms of the TPB highlight its over reliance on self report measures, and its reduced suitability to predict attitude behaviour, especially observed behaviour. Research has supported this criticism, with a meta-analytic review of 185 independent finding lower recorded levels of observed behaviour in relation to self reported behaviour studies (Armitage & Conner, 2001).

Aberg and Warner (2008) combined the TPB with the Driver Behaviour Questionnaire (DBQ), which assesses Reason’s error taxonomy theory (1990). They used this combination to predict and explain drivers speeding behaviour, through 175 driver’s questionnaire data analysis. They found that alone or in combination, the two frameworks could explain 38-53% of self reported speeding, and 24-26% of observed speeding.

This research illustrated the same limitations of previous TPB research through it’s over reliance on self report measures which do not accurately predict to observed behaviour, resulting in reduced predictive power. Despite these limitations however, the TPB is believed to be the most referenced model in traffic pyschology in recent years (Glendon, 2011).
Traffic Behaviour Theories

Risk homeostasis theory

Cyclist specific traffic psychology research is limited, with the majority of research focusing on motorist’s behaviour. The Risk Homeostasis Theory (RHT) of Gerald Wilde states that driver behaviour can vary in response to the perceived level of risk present in a situation, and the level of risk the motorist is comfortable with (Wilde, 1982). A key element of the RHT implies that upon improvement of driving technique, drivers, who subsequently have greater confidence and perceived situational control, exhibit more risk taking behaviour due to increased risk tolerance. It focuses on the process of risk compensation, suggesting that motorists attempt to maintain a consistent risk level when driving, in order to maintain an optimum level of task difficulty, regarding individual risk perception as a stronger predictor of driving behaviour than environmental conditions.

The RHT also suggests that through the development of risk behaviour actions, when the skill level or perceived level of control of the situation increases or decreases, an individual may then perform additional risk behaviours or reduce risk behaviour to further maintain this risk-threat equilibrium (Passer et al, 2009).

Research by Stanton & Pinto supports this theory. Using a driving simulator to recreate poor driving conditions, with speed and overtaking as their key variables, they found that drivers adjusted their driving behaviour to maintain a constant level of risk relevant to their visibility (2000).

Criticisms of the RHT, and its subsequent successor the Zero Risk Theory (ZRT) which stated behaviour was adjusted upon reaching a certain task difficulty threshold, (Summala 1997) have focused on their limitations of unfalsifiability and testability, their risk
compensation mechanisms and the lack of a shared model of testing to determine a theory’s higher validity in relation to other traffic psychology theories (Adams, 1988). Furthermore, Ranney (1994) argues that many traffic psychology theories are more descriptive than predictive of motorist behaviour.

Task difficulty homeostasis theory and risk allostasis theory

Development of the original theory of Wilde has given rise to more recent theories such as the Task Difficulty Homeostasis Theory (TDHT) (Fuller & Santos, 2002), and its successor; the Risk Allostasis Theory (RAT) (Fuller, 2011). Risk allostasis is the adjustment of an individual’s risk perception threshold, and the dynamic interpretation of preferred task difficulty and perceived capability (Fuller, 2011). These two theories have attempted to expand and improve on previous theories of traffic behaviour, placing less emphasis on risk and more on the task difficulty/capability cognitive processes (Fuller, 2008). The TDHT states drivers have a desired range of experienced task difficulty that they are comfortable operating under. It is a dynamic process determined by perceived capability, effort motivation and goals of the relevant journey, which allows for variance both between and during commutes.

The TDHT was positively received (Rothengatter, 2002) due to its removal of an over-emphasis on risk as a controlling factor of traffic psychology, while incorporating the risk threshold process of the ZRT, in relation to risk perception. The TDHT incorporates the components of preferred task difficulty with the perceived capability process, while using risk perception as a warning mechanism to alert the individual to exceeding of the preferred task difficulty, with this risk threshold equating to a ‘feeling of risk’ (Fuller, 2008).
Fuller (2008) incorporated the TDHT into the RAT, with the key development being the addition of risk perception as a dynamic and interchangeable factor with the acceptable range of task difficulty. This interchangeability of perceived task difficulty and risk perception refers to research that suggested their covariance. The RAT suggests that road users constantly monitor risk perception as an indicator of perceived task difficulty, with the reaching of a threshold point triggering an increased risk perception influence on decision-making (Fuller, 2008).

Multiple comfort zone model

The motivational model of driver behaviour, the Multiple Comfort Zone Model (MCZM) (Summala, 2005; Summala, 2007) may provide more immediate ease of applicability to cyclist behaviour. It is an adaption of the ZRT (Naatanen & Summala, 1974), focusing on drivers’ excitatory motives, personality and driving goals as prevailing factors for driver behaviour. Summala suggests it is through these motives that drivers interact with the traffic system and their behaviour is shaped through attempting to meet these goals. Motives may include arriving on time, saving energy/fuel, and taking pleasure in driving; and may be viewed as contributing factors towards higher or lower levels of risk taking (Summala, 2005; Summala, 2007).

The MCZM focuses on maintaining safety margins with a feeling of risk acting as a warning rather than serving as an optimum target for balance between task capability and task difficulty as outlined by the TDHT (Summala, 2005; Summala, 2007).
These theories of driver behaviour may not directly apply to cyclist behaviour. Factors such as the complex mechanisms of the driver behaviour models (due to the increased cognitive workload which may be required while driving), the physical difference in transport methods, or the social aspects such as increased responsibility for passengers are just a few examples of variables which may render these theories inapplicable to cycling.

Despite these factors, and the lack of a proven association between driver and cyclist behaviour, specific attributes of these theories, for example risk perception or task capability, may still be fundamental elements in cyclist’s decision making process, and for this reason these theories warrant consideration when examining cyclist behaviour.
**Previous Cyclist Research**

Dublin cyclist observational research carried out in Dublin City over two days reported 19% of cyclists break red lights, while 73% do not wear helmets (Cunningham, 2012). Researchers on behalf of Semperfit Tyres concluded that 46% of cyclists fail to observe the rules of the road, with the main infringements being cycling on foot paths (21%) and breaking red lights (19%). The study found that more cyclists observe the rules of the road than break them.

Cyclist age was recognized as an important factor in cycling behavior, with younger cyclists, and in particular 66% of teenagers more likely to ignore the rules of the road than cyclists over 50 years of age.

This research is in line with cyclist research from Australia, which showed that men are more likely than women to break red lights, and that younger cyclists (aged 18-29), where more likely to disobey the rules of the road than those in older age brackets (Johnson, Newstead, Charlton & Oxley, 2011).

Questionnaire research by the Institute for Advanced Motorists (IAM) in the UK claimed that 57% of cyclists break red lights and 73% cycle on foot paths, yet further examination of these figures reveals that only 13.3% of cyclists claimed to break red lights frequently or sometimes, with 42.7% claiming to never break red lights (MacMichael, 2012).

Transport for London conducted observational research of 7,502 cyclists across five locations examining red light running. The survey found 16% of cyclists broke a red light, with the majority of the violations occurring when cycling straight ahead (54%) compared with turning left (24%) or turning right (18%) (Tarrier, Abbott, Batchelor & Obee, 2007).

Cyclist research conducted in Australia, where helmet use is compulsory, found that cyclists who did not wear helmets are more likely to ignore other laws and take more risks while cycling than helmet wearers (Bambach, Mitchell, Grzebieta & Olivier, 2013).
Cyclist Level

Competitive and recreational motorist behavior has been studied, suggesting a link between motor racing and road accidents on public roads (Cestac, Paran, Delhomme 2011). An Australian case study by Tranter & Warn revealed a significant relationship between motor racing interest and pro-speeding attitude, with a positive correlation between motor racing interest and speeding intention (2008).

Questionnaire research carried out in New Zealand by Warn, Tranter and Kingham supported this study (2004). They found an association between motor sport history and risky driving behavior on public roads. Simulator based research has shown that experienced drivers are more likely to show anticipatory avoidance of a hazard, through dynamic adjustment, and maintain a more constant level of task difficulty over time, eliminating potential risks before they are encountered, therefore raising their risk threshold (Saad, Delhomme & Van Eslande, 1990). This research is particularly significant as it supports the the risk threshold element of the TDHT.

Further to driver research, competitive and recreational cyclists have been shown to differ on certain personality attribute scales and have different social, personal and psychological motives for cycling (Gat & McWhirter, 1998). Questionnaire research of 1,239 male and female cyclists in California examined the motives behind cycling participation. It found that male cyclists were more likely to endorse competition than female cyclists, and competitive cyclists were more likely than non competitive cyclists to endorse goal achievement and competition as reasons for cycling (LaChausse, 2006).

This research will investigate if competitive and recreational cyclists differ in self reported risk behavior scoring, as the previous research outlined suggests there may be significant differences in behaviour tendencies between sub groups of road users based on experience, attitude and motives.
**Personality (Neuroticism)**

Personality factors have been shown to influence social behaviour, across multiple cultures, suggesting it is an important consideration in the study and prediction of behaviour (Paunonen, Haddock & Forsterling, 2003). Questionnaire based research by Machin and Sankey (2008), suggests that excitement seeking, altruism and aversion to risk taking are important variables in the risk behaviour decision making process.

There is also a relationship between certain personality traits and risky driving behaviour. Self-report based research has shown that certain personality factors influence driver behaviour in certain groups, with internal influences (such as personal dispositions) affecting driver behaviour (Newnam, Newton, McGregor & Myles, 2008).

More specific questionnaire based traffic psychology research conducted in Norway, focusing on personality traits and social influences in relation to risk taking behaviour of young drivers, suggested that personality primarily influences risky driving behaviour through affecting attitudinal determinants of behaviour, with normative variables and past behaviour other important determinants (Ulleberg & Rundmo, 2003).

Research on the influence of personality on motorist crash involvement in Adelaide found no significant relationship between personality characteristics and crash involvement before or after questionnaire administration, but found that driving in a competitive manner predicted crashes for the following three years (Wundersitz, 2008).

Research suggests young drivers underestimate the risks associated with driving, with personality factors an important influence on risk perceptions and driving behaviour (Ferriera, Martinez & Guisande, 2009).
Neuroticism is a fundamental personality trait in the main factor theories of personality. It is characterized by anxiety, moodiness, worry, envy, guilt, and jealousy. Individual’s of higher neuroticism scoring respond poorer to environmental stress and perceived threatening situations. Neuroticism may be a cause or symptom of unpleasant life experiences and behavioral problems, and has been found to be a direct causal link to stress reactions (Matthews, Deary, Whiteman, 2003). Neuroticism has also been associated with social difficulties such as social interaction and poorer quality social relationships (Berry, Willingham & Thayer, 2000).

Experimental task research on neuroticism with an Italian sample of varying age and gender discovered that personality factors predicted levels of risk taking, with high scores on openness to experience associated with greater risk taking, and high scores on neuroticism associated with less risk taking (Lauriola & Levin, 2001).

Moore and Gullone (2000) looked at the relationship between personality types and risk behaviour among adolescents. They split risk behaviour into four categories; thrill-seeking risk behaviour, reckless risks, rebellious risks and antisocial risks. Personality was studied based on the five-factor personality inventory questionnaire, which has been shown to be a consistent method of personality factor assessment (Hendriks, Hofstee & De Raad, 1999). They discovered that female adolescents scored higher on neuroticism and agreeableness, and that risk judgments, personality factors, age and gender were significant predictors of risk behaviour; however, the personality factor of significance was found to differ depending upon the risk type, with the research being most successful in predicting rebellious risk taking and least successful in thrill seeking tendencies.
Personality and risk taking questionnaire research using the NEO five factor inventory assessing sensation seeking behaviours has also suggested a correlation between neuroticism scoring and risk scoring in older adults (Anic, 2008).

Low neuroticism scoring has been associated with driving fatalities. Analysis of road fatality data from 34 countries by Lajunen (2001) investigating the relationship between personality, work and traffic fatalities found that neuroticism correlated negatively with road fatalities. Lajunen’s findings were reached by comparing the national means of the three factors of extraversion, neuroticism and psychoticism on the Eysenck Personality Questionnaire devised by Eysenck & Eysenck (Passer et al, 2009).

While these research examples have shown there is a clear link between personality and risk behaviour, the role of personality in risk behaviour is still unclear (Iversen, Rundmo & Klempe, 2005). The vast majority of research on the relationship between personality and traffic risk behaviour has focused on driver behaviour. Research focusing on the relationship between neuroticism and the risk behaviour tendencies of Dublin cyclists may provide a basis for further, more comprehensive cyclist personality research, providing greater understanding of the Dublin cyclist population.
*Gender*

The gender schema theory suggests that individuals become ‘gendered’ into society, through gender based schematic processing. It states that characteristics linked with either sex are maintained and passed on to other members of a culture. One of its main arguments is that the self concept is interlinked with the gender schema (Bem, 1981). Gender schemas are organized mental structures containing our understanding of the attributes and behaviours that are appropriate and expected for males and females (Passer et al., 2009).

Gender differences in risk analysis are supported when investigating driver behaviour and traffic psychology. Meta analysis of 150 studies of the risk-taking tendencies of male and female participants was compared, which found greater risk taking tendencies among male participants (Byrnes, Miller & Schafer, 1999).

More recent French driver risk research indicates males partake in more risk taking behaviour in relation to driving than females, with men reporting slightly higher intentions to speed than women in questionnaire research of 3,002 drivers, with the intention increasing with driving experience (Cestac, Paran & Delhomme, 2011). Research by Transport for London on red light violations across London found that 17% of males disobeyed traffic signals compared to 13% of females (Tarrier, Abbott, Batchelor & Obee, 2007).

Direct cyclist gender research has not been conducted in relation to risk behaviour, with the statistical information on cyclist behaviour being non specific in nature (Lawson, Pakrashi, Ghosh & O’Brien 2011; Cunningham, 2012). A better understanding of male and female cycling risk behaviour variance may benefit future social marketing campaigns in relation to traffic psychology, and cyclist safety, as more gender specific safety awareness could prove more efficient in reducing cyclist accidents & fatalities.
The ratio of male to female cyclists in Ireland is 3:1 (CSO Ireland, 2006). The EU ratio of male to female road deaths is 4:1, with males accounting for 70% of Irish cyclist road deaths in 2010 (Jost, Allsop, Steriu & Popolizio, 2011).

The research of the study will be based upon the MCZM, RAT, TDHT, and the TPB and Driver Behaviour Questionnaire (DBQ) combination approach. The observed and self reported research will be supported by the TPB, with the substitution of the DBQ with the Adolescent Cyclist Behaviour Questionnaire (ACBQ), which itself is a modification of the DBQ. Cyclist level, personality and gender research will be based on the MCZM, while general risk perception and evaluation will be supported by the TDHT and RAT models of driver behaviour, specifically the ‘feeling of risk’/risk perception and task difficulty elements.
Rationale

The main purpose of this research is to provide a more comprehensive and up to date representation of Dublin cyclist’s risk behaviour. With the sharp increase in cycling in Dublin in the last two years (Gormley, 2012), more up to date risk behaviour research would better represent cyclists in Dublin.

Research examining the use of self report measures for driver behaviour found socially desirable response tendencies to influence DBQ scores on certain items (Lajunen & Summala, 2003). Combined with the limitations of self report research methods discussed previously in relation to the TPB, the use of both observational and questionnaire based research methods may facilitate a more detailed and accurate portrayal of Dublin cyclist’s.

Previous research in Ireland on cycling risk behaviour is limited, and in some cases the validity of the research has been brought into question (Cunningham, 2012). There is a common public perception across Ireland that the majority of cyclists do not obey the rules of the road and engage in risky behaviour while cycling. This research intends to provide a more comprehensive review of red light breaking and helmet use by Dublin cyclist’s to encourage a better informed public perception of Dublin cyclist’s.

Risk behaviour research in regards to traffic psychology has largely focused on motorist behaviour, with very limited cyclist-specific risk behaviour research available. The influence of competency level, gender and personality on risk behaviour across multiple domains and other modes of transport have been examined but risk behaviour theories have not been directly applied to Dublin cyclists, to determine if motorist risk behaviour tendencies apply to cyclist risk behaviour, or if risk behaviour recorded in other circumstances apply to cyclist’s.
One of the purposes of this research will be to investigate if the risk behaviour of Dublin cyclist’s is reflective of previous research, and to determine if gender, competency level and personality are significant factors in the risk behaviour of Dublin cyclists.

The experimental design of this research will be a combination of observational and questionnaire based data collection.

General cyclist demographic information will be recorded using a customised questionnaire by the researcher containing questions on age, gender and cyclist level. Self reported risk behaviour data will be recorded via the ACBQ.

Personality scoring for the specific purposes of neuroticism scoring will be recorded using the Big Five Inventory (BFI) questionnaire.

Dublin cycling risk perception will be investigated using three likert scale questions on cycling in Dublin.

To ensure an accurate reflection of cyclist behaviour is achieved, observational research will be conducted at four randomly selected locations at four randomly selected times across Dublin City, as this will ensure a more accurate representation of Dublin cyclist’s risk behaviour, as risk behaviour tendencies of Dublin Bike’s users, which are primarily used in the central area of Dublin City may not be representative of Dublin’s larger cycling community (Deegan, 2011).
Hypotheses

This research will examine the possible variance between observed and self reported risk behaviour of Dublin cyclists. It is hypothesized that observational research will reveal lower levels of red light breaking and helmet use compared to self reported research, in line with previous TPB research.

This research will compare observed and self reported risk behaviour findings to recent cyclist research carried out in Dublin. It is hypothesized that more extensive observational research in combination with self reported cycling risk behaviour in Dublin will reveal significantly lower levels of cycling risk behaviour than previous Dublin cyclist research.

This research will investigate the relationship between cyclist level (recreational and competitive) and risk behaviour. It is hypothesized that recreational cyclists will record significantly lower levels of cycling risk behaviour than competitive cyclists.

This research will investigate if there is a relationship between neuroticism levels and risk behaviour tendencies. It is hypothesized that a significant negative correlation between neuroticism scoring (BFI) and risk behaviour scoring (ACBQ) will be shown.

This research will investigate the difference between male and female cyclists in relation to self reported risk behaviour. It is hypothesized that male cyclists will have significantly higher risk behaviour tendencies than female cyclists, illustrated by both observed and self reported risk behaviour.
This research will investigate the perceived risk of Dublin cyclists. It will examine the difference between cyclist’s own perceived risk behaviour and their perceived risk behaviour of other cyclists. It is hypothesized that significantly lower levels of own perceived risk behaviour will be recorded in comparison to perceived risk of other cyclists.

It will examine the association between cyclist level and perceived cycling risk in Dublin. It is hypothesized competitive cyclists will report lower levels of perceived risk of cycling in Dublin than recreational cyclists.

It will examine the relationship between average weekly distance cycled and perceived cycling risk in Dublin. It is hypothesized that a significant negative correlation will exist between average weekly cycling distance and perceived risk of cycling in Dublin.
Method
Participants

Questionnaire Research

Participants were randomly selected, using two methods of self reported data collection; online questionnaire and printed questionnaire. The sample used for the self reported research was taken from the cyclist population of the greater Dublin area. There were two requirements for inclusion in the sample; the respondent must have been over 18 years of age, and must cycle in Dublin.

An email detailing the research being conducted and containing a link to the online questionnaire was sent to all Cycling Ireland officially registered cycling clubs, requesting voluntary member participation in the survey. The online questionnaire was also circulated via the social media platform Twitter, spread by word of mouth and through email. Dublin cyclist lobbying and awareness groups were also contacted regarding completion of the survey. Printed questionnaire participants were approached exiting two bicycle shops in Dublin City (Cycleways and Cyclelogical), at which point their voluntary participation was requested.

The total number of cyclists who completed questionnaire was 175; 154 completed the online questionnaire and 21 completed the printed questionnaire. The age range of questionnaire participants was between 19 and 69. The mean age was 34.55. The standard deviation of participant age was 10.39. The gender split of questionnaire participants was 134 male and 41 female. Cyclist level split was 53 competitive cyclists and 122 recreational cyclists.

Participants of both self reported data collection methods were not offered any incentives to participate in the survey research.
Observational Research

The sample used for observational research was of cyclists observed at specific locations and times selected using multi-cluster sampling across Dublin City. There was one eligibility criterion to be met to be considered suitable for inclusion in the sample; cyclist’s must of appeared to be over 18 years of age. Any person cycling a bicycle passing through the junction selected for observation who met this criterion was automatically considered part of the observational research sample.

The total number of cyclists observed at the four locations was 544. The observational gender split was 413 male and 132 female.
Design

This research design was quasi-experimental. It was a combination of qualitative, cross sectional, structured, natural, non disguised, direct observational research of cyclists on Dublin City roads, combined with a quantitative, questionnaire survey design correlation study, which was descriptive in nature.

The independent variable for the observational element of the research was gender (male, female). The dependent variables were red light breaking and helmet use.

The independent variables for the self reported part of the research were gender (male, female) and cyclist level (recreational, competitive). The dependent variables were ACBQ scoring, neuroticism scoring and perceived risk scoring.

Participants were assigned to groups based on gender observation during naturalistic observation. Self reporting of gender and cyclist level on the questionnaire determined participant’s grouping for the self reported research.
Materials

A complete version of the questionnaire used including the consent form and support details can be found in the Appendix section (Appendix A). The online questionnaire was created using Google Docs. It was identical to the printed version. The questionnaire consisted of four questionnaire sections; a cyclist demographic questionnaire, the big five inventory, the adolescent cyclist behaviour questionnaire, and a perceived risk questionnaire. Participants were advised in writing before beginning the questionnaire that all questions must be answered. The online questionnaire was designed so that it was not possible for participants to progress onto the next page of the questionnaire unless all previous questions had been answered. A stopwatch was used to ensure observation time was kept to one hour. An observation sheet designed by the researcher was used to record observed cyclist’s data (Appendix B).

Cyclist Demographic Questionnaire

The cyclist demographic questionnaire used was a seven item questionnaire custom designed by the researcher to obtain data regarding participant gender, age, cycling level, cycling experience (in years), Cycling Ireland membership, helmet use and average weekly distance cycled (in kilometres). Participants were provided with two options for most questions. The average distance cycled weekly item required participants choose from one of eight distance categories ranging from 1-20 to 141 plus kilometres.
The age item required participants enter their age in the space provided. This questionnaire
design is common in survey research and is a standard method of demographic data
collection.

*The Big Five Inventory*

The Big Five Inventory (John & Srivastava, 1999) is a 44 item, likert scale, self-report
inventory designed to measure the big five dimensions of personality. The big five
dimensions of personality are openness, conscientiousness, extraversion, agreeableness and
neuroticism. They are also commonly referred to as part of the Five Factor Model (FFM).
Eight questions related to extraversion, eight to neuroticism, nine to agreeableness, nine to
conscientiousness and ten to openness. The questionnaire was received from Michael Nolan
of Dublin Business School. The questionnaire started with the statement ‘I see myself as
someone who’, and then listed 44 examples of personality traits. The participants were to
rank the extent to which they agreed or disagreed with each statement, choosing from five
options; disagree strongly, disagree a little, neither agree nor disagree, agree a little and agree
strongly. Only one option per statement was allowed.

Cross-cultural tests of the (FFM) of personality in more than 50 societies across six
continents have supported the existence and universality of the FFM (McCrae, 2002). The big
five inventory questionnaire has been used to measure personality in numerous studies since
its conception, and it has been shown to be a reliable method of personality measurement
(Worell & Cross Jr., 2004).
Adolescent Cyclist Behaviour Questionnaire

The adolescent cyclist behaviour questionnaire was developed by the Dutch Institute for Traffic Safety Research (Twisk, Vlakveld, & Commandeur, 2007). It is a 22 item likert-scale questionnaire used to measure risky bicycle behaviour. The 22 items are categorised in three groups; errors, common violations and exceptional violations. The ACBQ is a modification of the Driver Behaviour Questionnaire (DBQ), a 50 item Likert scale questionnaire designed by Reason, Manstead, Stradling, Baxter & Campbell (1990) to assess a driver’s risk behaviour over the previous 12 months. The ACBQ was requested and received from Hans Feenstra, a co-author of previous cycling risk behaviour research (Feenstra, Ruiter, Schepers, Peters & Kok, 2011) which used the ACBQ.

Participants were asked to state the number of times they performed 22 different kinds of intended or unintended risky cycling behaviour (e.g. “riding a bike when under the influence of alcohol”, “using a mobile phone while cycling” and “forgetting to signal when changing directions”). Scores on these items ranged from one to six, one = never, six = always. One answer was to be selected per question, with no omissions permitted.

Meta analysis of 174 DBQ studies in conjunction with self reported accident records showed the DBQ to be a valid measurement scale of driver risk behaviour, with errors and violations scoring on the DBQ serving as a predictor of accident involvement (Winter & Dodou, 2010). The ACBQ has not been used as extensively as the DBQ but it has been found to be a useful instrument in measuring risky cycling behaviour (Feenstra, Ruiter, Schepers, Peters & Kok, 2011).
Perceived Risk Questionnaire

The perceived risk questionnaire is a three item scale questionnaire specifically created by the researcher to measure self reported general cycling behaviour, perceived general cycling behaviour of other Dublin cyclists and perceived cycling risk in Dublin. For each of the three items participants were instructed to choose a number between 1 and 10 which represented their opinion, with 1 = ‘very safe’ and 10 = ‘very risky’. The purpose of this questionnaire was to determine participant’s views of their own cycling behaviour, other Dublin cyclist’s behaviour, and the safety of cycling in Dublin.
Procedure

**Observational Research**

The observational research was conducted between February 12\textsuperscript{th} and February 20\textsuperscript{th} 2013. Multistage sampling, which is a form of cluster sampling, was used for sample selection. Multistage sampling involves dividing up the population into a number of groups or primary stages, from which sampling is carried out in stages using smaller and smaller sampling units at each stage. A two-stage sampling design was used for this research.

The area for selection of observation points chosen was between the Royal Canal and Grand Canal. A grid map of Dublin City (Appendix C) was used to split this area into four sections.

Each section contained four grids:

- **Section 1**: 1A, 1B, 2A and 2B
- **Section 2**: 1C, 1D, 2C and 2D
- **Section 3**: 3A, 3B, 4A and 4B
- **Section 4**: 3C, 3D, 4C and 4D

Every junction for section 1 was individually written on a piece of paper and folded over until unrecognisable and placed in a bowl. Each date between the 11\textsuperscript{th} and 24\textsuperscript{th} of February inclusive was individually written on a piece of paper, folded over until unrecognisable and placed in a second bowl.
Hourly segments between 08:00 to 18:00 were individually written on a piece of paper, folded over until unrecognisable and placed in a third bowl. One piece of paper was then selected from each of the bowls to determine a day, time and location for observation.

This process was then repeated for section’s 2, 3 & 4. After selection of pieces of paper containing the dates and times, they were folded back up and placed back in their respective bowls. The bowl containing the junctions from section 1 was replaced with a bowl containing the junctions from the next section. This process resulted in four locations for observation being selected. The observation locations are marked with a yellow circle on Appendix C. Photos of the four locations taken using Google Street View can be found in the appendix section as detailed below.

1. North King Street and Church Street/Constitution Hill, 12th February, 15:00-16:00
   (Appendix D & E)

2. Amiens Street and Seville Place/Portland row, 18th February, 17:00-18:00
   (Appendix F & G)

3. Fitzwilliam Street and Lower Baggot Street, 15th February, 13:00-14:00
   (Appendix H & I)

4. Meath Street and Thomas Street junction, 20th February, 09:00-10:00
   (Appendix J & K)

Four data columns were used on the observation sheet for each cyclist observed; Number, Gender, Helmet Use, and Red Light Breaking. The number column recorded the number of cyclists observed. Cyclists were recorded as ‘F’ for female and ‘M’ for male in the gender column. Helmet use and red light breaking was recorded with a ‘Y’ for yes and ‘N’ for no in their respective columns.
**Questionnaire Research**

This research was completed in two ways, via an online questionnaire and a printed version of the questionnaire. The questionnaire was counterbalanced, with the first 75 online participants completing the BFI, ACBQ and PRQ questionnaire sections in the opposite sequence to the second 75 online participants. Every second printed questionnaire completed was counterbalanced.

Online participation required respondents filled out the entire questionnaire on their computer while connected to the internet. They were required to click ‘next’ upon completion of each page/stage, and click ‘submit’ on the final page.

Before starting the questionnaire, participants were informed that the research related to Dublin cyclists’ risk behaviour and was being conducted as part of Dublin Business School undergraduate studies. They were informed in writing that they had the right to withdraw at any stage and that in this case their questionnaire data would not be collected. Participants were informed that certain items may evoke negative feelings, and that counselling services and other support information would be provided upon completion (detailed on the final page of Appendix A) or withdrawal. Participants were informed the questionnaire was completely anonymous and responses could not be attributed to any particular participant.

Upon completion of the questionnaire, all participants were provided with information for contacting support services should the questionnaire bring about any negative feelings. Contact information for Dublin Business School was also provided. Contact details were provided for both the researcher and supervisor, and participants were encouraged to contact the researcher with any questions regarding the questionnaire or project.
Print questionnaire participants were asked if they had any questions they would like answering regarding the questionnaire and research. Once they returned the questionnaire upon completion, it was checked by the researcher to have all sections completed.

As all participants were over the age of 18, informed consent or any other ethical considerations were not necessary for the observational or self reported research.
Results
Observed versus Self Reported Risk Behaviour

As shown in Table 1, 112 cyclists (30.3%) were observed breaking a red light. Two hundred and seventy-three cyclists (50.2%) were observed wearing a helmet.

Table 1

*Observed & self reported red light breaking and helmet use descriptive statistics*

<table>
<thead>
<tr>
<th>Method</th>
<th>Variable</th>
<th>N</th>
<th>Applicable</th>
<th>Yes</th>
<th>No</th>
<th>Yes %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Observation</strong></td>
<td>Red light</td>
<td>544</td>
<td>370</td>
<td>112</td>
<td>258</td>
<td>30.3%</td>
</tr>
<tr>
<td></td>
<td>Helmet</td>
<td>544</td>
<td>544</td>
<td>273</td>
<td>271</td>
<td>50.2%</td>
</tr>
<tr>
<td><strong>Self report</strong></td>
<td>Red light</td>
<td>175</td>
<td>175</td>
<td>131</td>
<td>44</td>
<td>74.8%</td>
</tr>
<tr>
<td></td>
<td>Helmet</td>
<td>175</td>
<td>175</td>
<td>147</td>
<td>28</td>
<td>84%</td>
</tr>
</tbody>
</table>
Self Reported Red Light Breaking

A more detailed analysis of the self reported red light breaking rates is illustrated by Figure 1 below. One hundred and thirty-one cyclists (74.8%) reported very rarely, rarely, sometimes or very frequently ignoring a red light. Seventy-five cyclists (42.8%) reported ignoring a red light occasionally or very frequently. Forty-four (25.2%) reported never ignoring a red light. No respondents reported always breaking a red light.

![Figure 1. Self reported red light breaking](chart.png)
Observed and Self Reported Risk Behaviour

Previous Research Comparison

Table 2 shows the observed and self reported red light breaking and helmet use percentage statistics of this current research in comparison to previous cyclist research carried out in Dublin. Due to limited self reported cyclist behaviour research, self reported red light breaking comparison was not possible.

Table 2

*Observed & self reported risk behaviour - previous research comparison*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observed red light breaking</th>
<th>Observed helmet use</th>
<th>Self report red light breaking</th>
<th>Self report helmet use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Research</td>
<td>30.3%</td>
<td>50.2%</td>
<td>42.8%</td>
<td>84%</td>
</tr>
<tr>
<td>Semperfitt Tyres (2012)</td>
<td>19%</td>
<td>27%</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Lawson, Pakrashi, Ghosh &amp; O’Brien, (2011)</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>54%</td>
</tr>
</tbody>
</table>

Cyclist Level

Table 3 illustrates the mean and standard deviation results for both cyclist categories. No significant difference between mean ACBQ scores for recreational and competitive cyclists was apparent.

An independent-samples t-test was used to compare cyclist’s level (recreational or competitive) and ACBQ scoring. There was no significant difference between recreational cyclist’s and competitive cyclist’s ACBQ scoring t(173) = -0.962, p = 0.337.

Table 3

*Cyclist level descriptive statistics*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean ACBQ Score</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreational</td>
<td>122</td>
<td>45.60</td>
<td>11.75</td>
</tr>
<tr>
<td>Competitive</td>
<td>53</td>
<td>43.81</td>
<td>10.31</td>
</tr>
</tbody>
</table>
Neuroticism

High neuroticism scoring participants represent 10.28% of the total respondent sample. Low neuroticism scoring participants represent 26.28% of the sample. Table 4 displays the ACBQ mean and standard deviation figures of high and low neuroticism scoring categories.

A pearson’s r correlation test was used to investigate the relationship between ACBQ scoring and neuroticism scoring. There was a no significant correlation found between the two variables (r = -0.032, n = 175, p = 0.676).

Table 4

*Neuroticism scoring descriptive statistics*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>ACBQ Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Neuroticism Scoring (≥4)</td>
<td>18</td>
<td>45.16</td>
<td>8.70</td>
</tr>
<tr>
<td>Low Neuroticism Scoring (&lt;3)</td>
<td>46</td>
<td>45.58</td>
<td>10.55</td>
</tr>
</tbody>
</table>
Gender

*Observed Risk Behaviour*

Table 5 presents the male and female observational descriptive statistics for observed red light breaking, observed helmet use and ACBQ scoring.

There was no significant difference between male red light breaking (31.1%) and female red light breaking (27.4%). There was also no significant observed helmet use difference between males (49.6%) and females (52.3%). There was no significant difference between male average ACBQ scoring (33.9%) and female average ACBQ scoring (34.9%).

Table 5

*Observed male and female red light breaking, helmet use and ACBQ scoring*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Yes %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obsv. Red Light</td>
<td>Male</td>
<td>286</td>
<td>----</td>
<td>----</td>
<td>31.1</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>84</td>
<td>----</td>
<td>----</td>
<td>27.4</td>
</tr>
<tr>
<td>Obsv. Helmet</td>
<td>Male</td>
<td>412</td>
<td>----</td>
<td>----</td>
<td>49.6</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>132</td>
<td>----</td>
<td>----</td>
<td>52.3</td>
</tr>
<tr>
<td>ACBQ scoring</td>
<td>Male</td>
<td>134</td>
<td>44.73</td>
<td>11.04</td>
<td>----</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>41</td>
<td>46.14</td>
<td>12.35</td>
<td>----</td>
</tr>
</tbody>
</table>
Self Reported Red Light Breaking – Gender Comparison

Figure 2 represents the ACBQ scores for self reported red light breaking, revealing that a significantly higher percentage of female cyclists reported never breaking a red light (39%) compared to male cyclists (20.9%). There was no significant difference in the occasional and very frequent red light breaking total between males (43.3%) and females (41.5%)

![Bar chart showing self-reported red light breaking by gender.](chart.png)

**Figure 2.** Male and female self reported red light breaking

A chi-square test was used to determine if there was a significant association between gender and self reported red light breaking. No significant association was found ($X^2(1), (N=175) = 8.047, p = 0.090$).
Self Reported Helmet Use – Gender Comparison

Figure 3 illustrates the self reported helmet use of male and female cyclists. Male cyclists reported higher helmet use (87.3%) than female cyclists (73.2%).

![Graph showing helmet use by gender]

**Figure 3.** Male and female self reported helmet use

A chi-square test was used to determine if a significant difference existed between self reported male and female helmet use. No significant association between gender and self reported helmet use was found ($X^2(1), (N=175) = 4.67, p < 0.05$).
Perceived Risk

As Table 6 illustrates, the self reported cyclist risk rating mean was 3.62. Other cyclists perceived risk mean was significantly higher at 6.83. The mean Dublin cycling risk score was 6.20.

Table 6

*Perceived risk questionnaire descriptive statistics*

<table>
<thead>
<tr>
<th>Perceived Risk</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own cycling behaviour</td>
<td>175</td>
<td>3.62</td>
<td>2.12</td>
</tr>
<tr>
<td>Other cyclists behaviour</td>
<td>175</td>
<td>6.83</td>
<td>2.27</td>
</tr>
<tr>
<td>Cycling risk in Dublin</td>
<td>175</td>
<td>6.20</td>
<td>2.05</td>
</tr>
</tbody>
</table>
Table 7 represents the mean perceived risk scoring based on cyclist level, neuroticism scoring and gender.

Table 7

*Perceived risk mean results by cyclist level, neuroticism scoring & gender*

<table>
<thead>
<tr>
<th>Variable</th>
<th>PRQ1: Own cycling risk behaviour</th>
<th>PRQ2: Other cyclists risk behaviour</th>
<th>PRQ3: Perceived risk of cycling in Dublin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclist Level</td>
<td>Recreational</td>
<td>3.74</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>Competitive</td>
<td>3.36</td>
<td>7.13</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>High</td>
<td>3.33</td>
<td>6.56</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>3.87</td>
<td>6.96</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>3.76</td>
<td>7.04</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>3.17</td>
<td>6.15</td>
</tr>
</tbody>
</table>

An independent-samples t-test was conducted to compare cyclist’s level (recreational or competitive) and self evaluation of perceived risk (PRQ1) and cycling risk in Dublin (PRQ3). There was no significant difference between recreational cyclist’s and competitive cyclist’s PRQ1 scoring t(173) = -1.084, p = 0.280, OR PRQ3 scoring t(173) = -0.128, p = 0.898).

A pearson’s r correlation test was used to investigate the relationship between average weekly cycling distance and perceived cycling risk in Dublin. No significant association was found (r= 0.004, n = 175, p = 0.953).
Discussion
Research Aims

The main aim of this research was to reduce the gap between the perception and reality of cyclist risk behaviour by providing more comprehensive and accurate information on cyclists risk behaviour.

The specific focus on two of the most controversial, and important elements of cycling behaviour – red light breaking and helmet use, served to establish a definitive baseline of observed and self reported behaviour tendencies which could be compared to previous research.

Observational and self reported research was used to provide a more accurate portrayal of cyclists through more detailed data collection. The sub categories of cyclist level, personality and gender served to provide a more comprehensive insight into cyclist behaviour while examining whether specific cyclist attributes were significantly associated with risk behaviour tendencies.

Perceived risk was also focused on to investigate possible self and peer risk perception differences, and to determine if cycling distance and cyclist level influences risk perception.
General Description of Results and Hypotheses Support

*Hypothesis 1: Observed versus Self Reported Risk Behaviour*

It was hypothesised that observational research would reveal significantly lower levels of red light breaking and helmet use, in line with previous TPB research. This hypothesis was supported, as observed red light breaking was significantly lower than self reported occasional/very frequent red light breaking. Observed helmet use was significantly lower than self reported helmet use.

*Hypothesis 2: Risk Behaviour versus Previous Research*

It was hypothesized that more comprehensive cyclist risk behaviour research would reveal lower levels of cyclist risk behaviour in comparison to previous Dublin cyclist research. Observed cyclists recorded higher red light breaking than previous research (Cunningham, 2012). This did not support my red light breaking hypothesis. Observed cyclists recorded higher helmet use compared to previous research (Cunningham, 2012). This finding did support my hypothesis of increased helmet use observation. Self reported helmet use was higher than previous self report helmet use research (Lawson, Pakrashi, Ghosh & O’Brien, 2011). Overall these findings did support my hypothesis of decreased risk behaviour.
Hypothesis 3: Cyclist Level and Risk Behaviour

It was hypothesized that recreational cyclist’s risk behaviour would be significantly lower than competitive cyclists risk behaviour. ACBQ scoring analysis revealed that there was no significant difference between the two groups; therefore this hypothesis was not supported.

Hypothesis 4: Neuroticism Scoring and Risk Behaviour

It was hypothesized that higher neuroticism scoring on the big five inventory would correlate with lower cyclist risk behaviour scoring. There was no significant relationship found between the two scores, thus this hypothesis was not supported.

Hypothesis 5: Gender and Risk Behaviour

It was hypothesized that male cyclists would record higher risk behaviour in both observed and self reported research methods. A higher percentage of female cyclists reported never breaking a red light. Male cyclists reported higher helmet use yet observational research did not reveal any significant difference in male or female red light breaking or helmet use behaviour. These findings therefore did not support this hypothesis.
Hypothesis 6: Self and Peer Perceived Risk

It was hypothesized that cyclists would view their own risk behaviour as significantly less risky than that of other cyclists. The results revealed a significant difference in self and peer risk behaviour evaluation, with cyclists viewing other cyclists’ behaviour as significantly riskier than their own. This hypothesis was supported.

Hypothesis 7: Cyclist Level and Perceived Risk

It was hypothesized that a significant difference between recreational and competitive cyclists’ self-evaluation of perceived risk and perceived cycling risk in Dublin would be recorded. No significant difference was found. This hypothesis was not supported.

Hypothesis 8: Average Weekly Cycling Distance and Perceived Risk

It was hypothesized that a significant relationship between average weekly cycling distance and perceived cycling risk in Dublin would be found. No significant association was found. This hypothesis was not supported.
Discussion of Findings

*Observational and Self Report Research*

The findings of this observational and self reported research supported the theory of planned behaviour and previous TPB based research which suggests attitude is linked to behaviour (Elliot, Armitage & Baughan, 2007). This was evident through respondents low perception of their own risk \( (m = 3.62) \), their view of cycling in Dublin as slightly risky \( (m = 6.20) \), and the low mean ACBQ score of 45.06 (26%) indicating respondents did not take high risks while cycling.

This research was based upon key elements of the task difficulty homeostasis theory and the risk allostasis theory, which suggest that task difficulty and feelings of risk are correlated. Respondents low scoring on the 11 ACBQ error questions \( (mean = 24.83) \), may be interpreted to suggest that cycling task difficulty is low. This may be an influential factor in the low perceived risk self evaluation \( (mean = 3.62) \). While there are no tests available to validate the TDHT, previous research conducted by Fuller, McHugh & Pender, examining 70 driver’s task difficulty and feelings of risk in relation to speed, found that ratings of perceived risk were highly correlated with ratings of task difficulty (2008). They suggested that feelings of risk may provide a motivational factor for avoiding excessive task difficulty, with drivers maintaining a low feeling of risk, thus resulting in low task difficulty perception.

The combination approach of pairing the TPB and ACBQ resulted in findings in support of previous TPB and DBQ combination research.
While self reported research suggested red light breaking (43%) and helmet use (84%) rates, observational research recorded lower rates of red light breaking (30%) and helmet use (50%).

This lower recorded level of observed behaviour in relation to self reported behaviour corresponded with meta-analytic research of 185 independent studies carried out by Armitage & Conner (2001), and motorist observed and self reported risk behaviour research (speeding) conducted by Aberg & Warner (2008), whose findings supported the limitations of the TPB in relation to differences in self reported findings and observational predictions.

**Observational and Self Report Research versus Previous Research**

The observational research findings in comparison to recent Dublin cyclist behaviour research (Cunningham, 2012) suggests a higher percentage of cyclists break red lights; 30% compared to 19%, but a higher percentage of cyclists wear helmets; 50% compared to 27%. These differences may be explained by the more comprehensive observational research conducted for this research, incorporating four different locations across Dublin City at four different times of observation, in comparison to the Semperfit Tyres roadside survey carried out over two days at two locations in Dublin (Cunningham, 2012).

The self report research of this study found cyclists to have a lower perceived risk of cycling in Dublin than previous research conducted by Lawson, Pakrashi, Ghosh & O’Brien (2011). The questionnaire based research of Lawson, Pakrashi, Ghosh & O’Brien (2011) collected data from 1,954 cyclists in the greater Dublin area, a sample size 11 times that of this current study, yet it asked cyclist’s to rate cycling risk in relation to driving.
These two factors may explain the higher risk rating recorded by cyclists, as cyclists in this study were simply asked to rate the risk of cycling in Dublin, irrespective of other modes of transport.

**Neuroticism, Cyclist level and Risk Behaviour**

The multiple comfort zone model states that excitatory motives, personality and driving goals act as the key factors in driver risk behaviour. This research examined the effect of neuroticism and cyclist level in relation to the MCZM, to investigate if neuroticism and cyclist level had an effect on self reported cycling risk behaviour.

Personality, in particular the neuroticism personality trait, has been shown to be significantly associated with driver risk behaviour (Ferriera, Martinez & Guisande, 2009). Competitive and recreational cyclists have been shown to differ on personality attribute scales and on psychological motives for cycling (Gat & McWhirter, 1998).

In this current research, there was no significant association found neuroticism and self reported risk behaviour while cycling. This finding does not support the neuroticism and competitive motorist/cyclist research previously discussed.

The MCZM is designed for motorist behaviour research, and as such its framework may not be entirely suited to cyclist behaviour interpretation. Survey research conducted with 77 cyclist’s from the United States on cycling preference (road or mountain biking), found no significant association between personality or sensation seeking values and cyclist preference, also suggesting that personality may serve only as a predictor for preference at a general level of sport selection (DuRoy, 2000).
The findings of this current research, does not support the competitive categorisation research mentioned previously. Its does lend support DuRoy’s suggestion however, as it suggests that personality and cyclist type does not reflect significantly different psychological values in relation to cycling sub categories.

The lack of testability of driver behaviour theories, combined with the lack of previous research applying traffic behaviour models to cycling makes significant findings or comparison of cyclist behaviour and previous traffic psychology research difficult. Further cyclist research is required, with more extensive personality, environmental and motivational factors taken into account in order to establish a more comprehensive understanding of the MCZM, RAT and TDHT applicability to cyclist risk behaviour.

**Gender**

The gender schema theory (Bem, 1981) suggests that we have organised mental structures containing appropriate attributes and behaviours for males and females, with research suggesting that in western cultures, males prize such attributes of achievement, emotional strength, athleticism and self sufficiency, with women prizing kindness and helpfulness amongst others (Beyer 1990; Marsh 1990 as cited in Passer, 2009).

Research has suggested that males engage in higher risk taking across multiple domains (Byrnes, Miller & Schafer, 1999; Ulleberg, 2001), and specifically while driving (Cestac, Paran & Delhomme, 2011). These findings are not without contradiction. Analysis of 24 previous gender focused risk studies by Nelson (2012) suggested that the gender difference for financial risk aversion is much lower than previously reported.
Experimental research has also suggested that social learning may have a more significant effect on female risk behaviour than gender traits (Booth & Nolen, 2011).

This current research found no significant differences between observed male and female red light breaking (male = 31%, female = 27%) or helmet use (male = 75%, female = 77%).

Occasional or very frequently self reported red light breaking (male = 43%, female = 41%) also showed no significant difference. Self reported helmet use (male = 80%, female = 61%) recorded the highest margin of difference but similar margins were not witnessed during naturalistic observation. These findings suggest that while driver risk behaviour research may suggest a gender difference in risk behaviour, this is not supported by cyclist risk behaviour in Dublin. These findings therefore support the research suggesting that gender differences in risk behaviour may indeed be domain specific.

Perceived Risk

Driver risk perception research conducted by Matthews & Moran (1986) with young and old male drivers, found that young drivers rated their own risk behaviour as lower than that of their peers. This research found that cyclists had a lower perception of their own risk to that of their peers, which supports the research of Matthews & Moran (1986). The perceived risk findings of this research suggest limited support for the risk perception element of the TDHT and RAT in cyclist behaviour, but without more detailed research incorporating additional stages of the TDHT or RAT into cyclist risk behaviour, and a more specific measurement of cyclist task difficulty, a significant association with the TDHT and RAT in relation to cyclist behaviour cannot be determined.
This is a potential problem of this study, as the unfalsifiable nature of driver behaviour models and the limited measures used to examine perceived risk and task difficulty prevent significant associations being made between risk perception and task capability, especially in relation to cyclists.

On the basis of the TDHT and the task capability factor, of which experience and training is associated, the relationship between average weekly cycling distance and perceived risk of cycling in Dublin was examined to investigate if cyclist’s risk perception would be negatively correlated with increased average weekly cycling experience. This association was not supported. This suggests the requirement of a combined evaluation of experience, education and training, in combination with other variables such as physiological competence to more accurately determine a task capability scoring for comparison with perceived risk scoring.
Strengths

Detailed research on cyclists risk behaviour is limited. The majority of risk behaviour in relation to traffic psychology focuses on driver behaviour. This research attempted to compare driver behaviour models to cyclist behaviour, while providing a more detailed analysis of possible influences on cyclist risk behaviour and perception. This was an original approach to examining Dublin cyclist’s behaviour, and no previous published cyclist research of similar intent could be found.

The combination of detailed observational and self reported cyclist risk behaviour provided a comprehensive cyclist risk representation, as it created accurate statistical analysis of Dublin cyclist’s behaviour, through the recording of observational data at different times and locations. Significant differences in helmet use and red light breaking were observed by the researcher during different observation sessions, highlighting the importance of comprehensive research methods.

The use of the ACBQ facilitated cycling domain-specific risk assessment, recording a more accurate risk behaviour measurement representative of cyclist’s true behaviour than a general risk aversion questionnaire might have provided.

The focus on cyclist risk behaviour across personality (neuroticism), cyclist level and gender were three categories that had not received specific focus in previous cycling research which merited investigation, and served to highlight the limitations of broadly applying research risk behaviour findings to multiple domains.

The inclusion of perceived risk items of risk behaviour revealed a significant difference between self and peer evaluated risk behaviour, and provided a better understanding of the risk perception of Dublin cyclists in comparison to previous research.
Weaknesses

While the ACBQ provided a reliable method of cyclist risk behaviour assessment, its lack of measurement of other important traffic psychology factors limited its effectiveness in providing detailed risk analysis. The inclusion of questionnaire material on environmental factors such as road surfacing, traffic levels and perceived behavioural control would have facilitated a more complete portrayal of cyclist risk behaviour factors.

Due to the ACBQ red light breaking likert scale question, direct comparison between observed and self reported red light breaking was difficult. A specific yes or no red light breaking item in the CDQ would have been provided a more direct comparison with previous research.

The factor of task difficulty could have been examined in a more significant manner through additional questions as part of the self report research, which may have provided a more significant association with the driver behaviour models TDHT and RAT, resulting in a better understanding of their possible application to cyclist behaviour. The inclusion of perceived task capability and perceived task difficulty items in the PRQ may have been one method of doing this.
Future Research

The findings of this research provide an overview of the level of cyclist risk behaviour in Dublin. Application of these findings may facilitate future research in relation to motives for cycling, an important area which warrants further research. The MCZM suggests that pleasure seeking is a significant consideration in driver motivation and behaviour. Future research on sensation seeking and its association with cyclist risk behaviour may provide greater understanding of the reasons for specific risk behaviour tendencies such as red light breaking or helmet use, as questionnaire research using the Driving Anger Scale among 224 college participants in the United States found sensation seeking to be an important factor in relation to unsafe driving prediction (Dahlen, Martin, Ragan & Kuhlman, 2005). The analysis of all five personality factors as part of the FFM may also reveal more significant relationships between other personality factors and cyclist risk behaviour.

Subjective norm influence is another factor which warrants future research. Survey research of 42 newly licensed drivers in Virginia, USA, suggested social influences may be an important factor in explaining risky driving behaviour among young adults (Simons-Morton, Ouimet, Zhang, Klauer, Lee, Wang, Chen & Albert, 2011). Cyclist survey research in The Netherlands suggested that the decision to commute by bicycle over short distances was influenced by subjective norms of what is considered the expected method of transport for such distances (Heinen, Maat & Wee, 2011). The specific examination of cyclist’s risk behaviour both in groups and individually in relation to subjective norms based on these driver and cyclist research examples may also help provide a better understanding of cyclist attitudes and behaviour justification.
Red light breaking by cyclists remains a controversial topic requiring further examination. Research in Australia using a national online survey questioned 2,061 cyclists on red light behaviour, reporting that turning left and lack of adequate traffic light sensor triggering were the two most reported reasons for red light infringement (Johnson, Charlton, Oxley & Newstead, 2013). Cyclist survey research conducted by the Institute of Advanced Motorists in England found that the main reason cyclists break red lights was due to safety concerns, as it allowed them to get away ahead of other traffic at dangerous junctions (Burgess, 2012).

These findings were supported by research highlighting the safety benefit to both cyclists and drivers of cyclists breaking red lights. Transport for London’s (TfL) road safety unit suggested that male cyclists who jump red lights may be safer than female cyclists as they were more likely to remain beside a vehicle at red traffic lights. Eighty-six percent of female cyclists killed in London from 1999-2004 collided with a lorry, with the TfL report suggesting that female reluctance to cycle through red lights may have placed them in the blind spot of lorry drivers resulting in fatal accidents upon acceleration away from traffic lights (Tran, 2010).

Traffic management infrastructural changes are been made in certain countries in an attempt to reduce these cyclist accident and fatality rates recorded at red light stops. Following on from the successful implementation of ‘cyclist only’ phases at traffic lights in Belgium, which allow cyclists to continue cycling while other traffic is stopped, the state of Illinois (excluding Chicago) has implemented a similar scheme, with Paris (France) introducing a small scale system with the view towards widespread expansion (Sage & Tourres, 2012).
These research examples and recent changes in traffic management protocol in other countries further highlight the importance of more extensive research into the motives for cyclist risk behaviour in Ireland. Safety reasons, efficiency, sensation seeking, poor road rules education and cultural influences may be important considerations in cyclists decision making processes, with a better understanding of behaviour motives allowing for more focused cyclist/driver road safety campaign’s and more effective improvements to traffic infrastructure in the future.
Concluding Statement

The main findings of this research were that 30% of cyclists break red lights, and 50% of cyclists wear a helmet. The limitations of self report measures for behaviour prediction was supported with lower helmet use and lower red light breaking rates observed than self reported. No significant association was found between neuroticism and risk behaviour, or cycling level and risk behaviour. No significant difference was found between male and female observed or self reported risk behaviour. The lack of findings in support of risk behaviour research from other fields suggests risk behaviour research findings may be domain specific. Dublin cyclists have a low perception of their own risk, but a significantly higher perception of other cyclists risk behaviour. Cycling in Dublin is perceived to be slightly risky.
References


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http://www.guardian.co.uk/uk/2010/may/21/women-cyclists-most-accidents

http://europepmc.org/abstract/MED/18760096/reload=0;jsessionid=aNqx2oBmWmLbp2tsL69r.6


www.sciencedirect.com/science/article/pii/S0925753501000777


Appendices
Appendix A

Self report questionnaire


Cyclist Level, Personality and Gender.

My name is Sean Waters. I am an undergraduate student at Dublin Business School. I am conducting research relating to cyclist risk behaviour in Dublin. This research is being conducted as part of my studies and will be submitted for examination.

You are invited to take part in this study. Participation is completely voluntary and you are not obliged to do so. Completion and submission of the following questionnaires will be considered consent to participate. This study is completely anonymous and responses cannot be attributed to any one participant. For this reason, it will not be possible to withdraw from participation after submission of the questionnaire.

While this questionnaire may ask some questions that may evoke some negative feelings, it has been used widely in research. Dublin Business School have counsellors and other support services available to you if this questionnaire raises any problems. Contact information for support services is included on the final page. If you have any queries I can be contacted by email at [redacted].

My supervisor Dr. Murphy may be contacted at Dublin Business School, 13-14 Aungier Street, Dublin 2, Tel: (01) 417 7500.

Thank you for taking the time to complete this questionnaire.

Sean Waters
Cyclist Demographic Questionnaire

Please circle each answer:

1. Gender *
   Male                Female

2. Age *
   (write below)
   ___________

3. Cycling Level *
   'Competitive' eg: a cyclist who enters races.
   Competitive         Recreational

4. Cycling experience *
   (in years)
   0-2                 2-5                 5+

5. Are you a member of a Cycling Ireland approved cycling club? *
   Yes                  No

6. Do you wear a helmet while cycling? *
   Yes                  No

7. What is the average distance you cycle weekly? *
   Measured in Kilometres (km)
   1-20km               21-40km              41-60km          61-80km         81-100km
   101-120km            121-140km           141km or more
**The Big Five Personality Inventory**

(John & Srivastava, 1998)

*Please check a box for each item to indicate the extent to which you agree or disagree with it.*

<table>
<thead>
<tr>
<th>I see myself as someone who...*</th>
<th>Disagree strongly</th>
<th>Disagree a little</th>
<th>Neither agree nor disagree</th>
<th>Agree a little</th>
<th>Agree strongly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is talkative....................</td>
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<td>2. Tends to find fault in others.</td>
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<td>3. Does a thorough job............</td>
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<td>4. Is depressed, blue.............</td>
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<td>5. Is original, comes up with new ideas...</td>
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<td>6. Is reserved......................</td>
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<td>7. Is helpful and unselfish with others.....</td>
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<td>8. Can be somewhat careless........</td>
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<td>9. Is relaxed, handles stress well.....</td>
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<td>10. Is curious about many different things...</td>
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<td>11. Is full of energy................</td>
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<td>12. Starts quarrels with others.........</td>
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<td>13. Is a reliable worker............</td>
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<td>14. Can be tense........................</td>
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<td>15. Is ingenious, a deep thinker..........</td>
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<td></td>
<td>Disagree strongly</td>
<td>Disagree a little</td>
<td>Neither agree nor disagree</td>
<td>Agree a little</td>
<td>Agree strongly</td>
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<tr>
<td>I see myself as someone who...*</td>
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<td>16. Generates a lot of enthusiasm</td>
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<td>17. Has a forgiving nature</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>18. Tends to be disorganized</td>
<td>☐</td>
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<td>19. Worries a lot</td>
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<td>20. Has an active imagination</td>
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<td>21. Tends to be quiet</td>
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<td>22. Is generally trusting</td>
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<tr>
<td>23. Tends to be lazy</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<td>24. Is emotionally stable, not easily upset</td>
<td>☐</td>
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<td>25. Is inventive</td>
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<td>26. Has an assertive personality</td>
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<td>27. Can be cold and aloof</td>
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<td>28. Perseveres until the task is finished</td>
<td>☐</td>
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<td>29. Can be moody</td>
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<td>30. Values artistic, aesthetic experiences</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>31. Is sometimes shy, inhibited</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>32. Is considerate and kind to almost everyone</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>33. Does things efficiently</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>34. Remains calm in tense situations</td>
<td>☐</td>
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<tr>
<td>I see myself as someone who...*</td>
<td>Disagree</td>
<td>Disagree a little</td>
<td>Neither agree nor disagree</td>
<td>Agree a little</td>
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<td>35. Prefers work that is routine</td>
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<td>36. Is outgoing, sociable</td>
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<td>□</td>
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<td>37. Is sometimes rude to others</td>
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<tr>
<td>38. Makes plans and follows through with them</td>
<td>□</td>
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<td>□</td>
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<td>39. Gets nervous easily</td>
<td>□</td>
<td>□</td>
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<tr>
<td>40. Likes to reflect, play with ideas</td>
<td>□</td>
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<td>41. Has few artistic interests</td>
<td>□</td>
<td>□</td>
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<td>42. Likes to cooperate with others</td>
<td>□</td>
<td>□</td>
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<td>43. Is easily distracted</td>
<td>□</td>
<td>□</td>
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<tr>
<td>44. Is sophisticated in art, music, literature</td>
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</table>
Perceived Risk

On a scale of 1-10, please circle the appropriate number:

(1 being very safe, 10 being very risky)

Q1. How would you rate your own cycling behaviour? *

1 2 3 4 5 6 7 8 9 10

Q2. How would you rate the general cycling behaviour of other Dublin cyclists? *

1 2 3 4 5 6 7 8 9 10

Q3. How would you rate cycling risk in Dublin? *

1 2 3 4 5 6 7 8 9 10
Cyclist Behaviour Questionnaire
(The Dutch Institute for Traffic Safety Research (SWOV), 2006)

While cycling please state to which degree of relevance you intentionally or unintentionally perform these actions: *

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Very Frequently</th>
<th>Always</th>
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<tbody>
<tr>
<td>1. Forget to signal when</td>
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<td>changing direction</td>
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<td>2. Cycle in threes</td>
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<td>3. Cycle on the footpath</td>
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<td>4. Use a mobile phone</td>
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<td>5. Forget to look behind</td>
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<td>when turning right</td>
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<td>6. Cycle when it is slippery</td>
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<td>and you could fall easily</td>
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<td>7. Cycle at night without</td>
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<td>a working front or rear light</td>
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<tr>
<td>8. Ignore a red traffic light</td>
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<td>9. Cycle so close to someone</td>
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<td>else, that the handlebars</td>
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<td>touched and you almost fell</td>
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<td>10. Swerve around</td>
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<td>crossing pedestrians</td>
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<td>at a zebra crossing</td>
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<td>11. Not see a car coming</td>
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<td>from a side street</td>
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<td></td>
<td>Never</td>
<td>Very Rarely</td>
<td>Rarely</td>
<td>Sometimes</td>
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<tr>
<td>12. Have to brake hard, because a car approached faster than you anticipated.....☐</td>
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<tr>
<td>13. Notice you ought to ride on a bike lane/path instead of a road..............☐</td>
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<td>14. Stop on the left side of a truck that wanted to turn left, instead of waiting behind it....☐</td>
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<td>15. Brake (too) late, because you were on someone else’s bike and the brakes worked differently..............☐</td>
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<tr>
<td>16. Feel uncertain about who had right of way on a roundabout.....................☐</td>
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<td>17. Cycle after drinking alcohol..........................☐</td>
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<td>18. Notice you entered a one way street on the wrong side..................☐</td>
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<td>19. Have to swerve to avoid getting run over by a bus or truck turning left............☐</td>
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<td>20. Get pushed or pulled by a moped rider..................☐</td>
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<td>21. Almost hit a crossing pedestrian..................☐</td>
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<td>22. Cycle while under the influence of marijuana or other drugs..................☐</td>
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Dublin cyclist's risk behaviour: Comparison of reported and observed behaviour.

cyclist level, personality and gender.

Thank you for taking the time to complete this questionnaire.

If you have any queries or if you would like a copy of the completed research please contact me at [redacted].

If this questionnaire has evoked any negative feelings, support services are available through Dublin Business School.

Support Services:
Dublin Business School Support Services
13-14 Aungier Street
Dublin 2
Tel: 01 4177530

Thank you,

Sean Waters
### Appendix B

**Observation Sheet**

Location: ___________________________ Date: __________ Time: __________

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Appendix C
Map of Dublin City

1. Grid 2B: North King Street & Church Street/Constitution Hill junction

2. Grid 2D: Amiens Street and Seville Place/Portland Row junction

3. Grid 3B: Fitzwilliam Street and Lower Baggot Street junction

4. Grid 3D: Meath Street and Thomas Street junction
Appendix D

North King Street and Church Street/Constitution Hill

View from North King Street
Appendix E

North King Street & Church Street/Constitution Hill

View from Church Street
Appendix F

Amiens Street and Seville Place/Portland Row

View from Amiens St Southbound
Appendix G

Amiens Street & Seville Place/Portland Row Junction

View from Seville Place
Appendix H

Fitzwilliam Street & Lower Baggot Street

View from Lower Baggot Street
Appendix I

Fitzwilliam Street & Lower Baggot Street

View from Fitzwilliam Street
Appendix J

Meath Street & Thomas Street

View from Meath Street
Appendix K

Meath Street & Thomas Street

View from Meath Street