Predictors of Irish 11 to 12-year-olds' Road Use Behaviour and Investigation of Associated Parental Risk Perception of Own and Child's Behaviour

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This research was conducted in the School of Psychology

DECLARATION

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Summary

This study sought to gain a better insight into the road use behaviour of primary school children aged between 11 and 12 years in Ireland. To do so required an assessment of their reported road use behaviour, their road safety beliefs, and their perception of risk. This assessment was followed for completeness by an assessment on how their behaviour relates to their parents' perceptions of risk and perceptions of their child's road use behaviour.

Chapter 1 provides a review of the relevant literature on psychological and behavioural factors that influence children's road use behaviour internationally. The review identifies the relevant psychological theory that potentially underly road use behaviour and highlights areas where future interventions can be focused.

Chapter 2 sets out the methodologies employed in this research. This large-scale research was carried out in two phases. The first study involved the analysis of self-reported road use behaviour in 1,100 children aged 11 to 12 years old in 42 Irish primary schools. Schools were sampled across the 26 counties in the Republic of Ireland ensuring a sound representative sample of Irish primary school children. The second study assessed the self-reported behaviour and road risk perception in 125 matched child and parent pairs. A complex set of statistical methods including HLM were employed to control for the nested data within the school structure.

Chapter 3 involved the validation of the Adolescent Road Users Questionnaire (ARBQ; Elliott & Baughan, 2004) for use in the 11 to 12-year-old population in Ireland through Confirmatory Factor Analysis and Exploratory Factor Analysis. Two iterations of a short scale were produced, with the final 20-item scale demonstrating strong reliability and discriminant validity. The present study confirmed the psychometric properties of the ARBQ in Ireland and deemed it appropriate for use in the 11 to 12-year-old primary school population in Ireland. This outcome will provide the Road Safety Authority (RSA) with a tool to effectively chart changes in primary school children's behaviour over time.

Chapter 4 Involved the in-depth analysis of the road use behaviours observed in the sample population and compared them to similar studies that utilised the ARBQ internationally. Irish children followed a similar trend to what was observed internationally, with the exception of dangerous play, which was more reflective of socialising in and around urban streets rather than extreme risk actives such as running across a street for a dare. Three sets of models were constructed through HLM modelling which identified a series of very insightful predictors of children's unsafe crossing, planned protective behaviour and dangerous play in Ireland. The interactions across the level 1(student) and level 2 predictors (school) confirmed the choice of HLM as the use of hierarchical linear modelling would have been unable to identify the unique contribution at school level independent of student level.

Chapter 5 examines the predictors of road use behaviour in children and their parents followed by the perception of road safety risk in both cohorts. It further highlighted the relationship between parents' beliefs regarding how their children behave while on the roads and how their children actually behave. It identified that parents may not be fully aware of their children's behaviour and, at times, appeared to be overestimating their abilities.

Chapter 6 provides a summary of each of the chapters.

Chapter 7 provides an overview of the research conducted, highlights the unique contribution to the literature and makes recommendations for future research and practice. This research has clearly highlighted the impact of peer influence and parental modelling on children's behaviour, both positive and negative. Another defining feature of this research is the power of past behaviour (near miss experience) and holding strong responsibility beliefs to predict road use behaviour.

Overall, this study has contributed significantly to the wider understanding of road use behaviours in 11- to 12-year-old children in Ireland, their road safety beliefs, risk perception and the corresponding behaviour and risk perception in parents. It has established a tool for the RSA to use to assess changes in primary school children's road use behaviour over time in Ireland and identified two key areas to reinforce: namely increasing road safety responsibility beliefs and the impact of parental modelling on children's predicted road use behaviour.

Acknowledgements

This thesis represents six years' research on children's road safety and developed as a natural extension of my dedication to the field of road safety since 2004. I would like to thank the Road Safety Authority for funding four years of this research, which was unfortunately brought to an abrupt halt due to COVID 19! However, we picked up the pieces and carried on! I also wish to thank participating schools, children, and parents for their contribution to this research as without them, it would not have been possible. I owe sincere gratitude to my supervisor and friend Dr Michael Gormley for his unwavering support and constant encouragement throughout this very long process. I am sure he feared it would never come to pass - but here it is! Apart from his role as a supervisor, I also need to thank him for bringing the most important mentor into my life, a person who has picked me up so many times and encouraged me to keep going when 'all around me was falling'. This amazing person is Dr Margaret Ryan. Her motivation and impact are such that an expression in our house is 'what would Margo do'! I am blessed to have her as a friend, and I am sure we will have great adventures ahead of us. Speaking of friends, I have a lovely bunch of ladies who have been waiting a long time to call me Doc Martin, so hopefully they can do that soon! Without their friendship I would be lost. Finally, I need to thank my family for their patience and love. A few days ago, I said to my daughter Clara, I have been working on this for half of your life and she said, 'I Know!' They have been through all my ups and downs along the way, so thank you to my beautiful girls Faith and Clara. I can't wait for more carefree days ahead with you both before you fly the coop. I hope this will show you that anything is possible when you put your mind to it. I need to thank my sister Ita for not only guiding me my whole life to keep my head up and carry on, but our friendship has grown so much this year through a series of very significant challenges life has thrown her and our way. It has taught me at the end of the day, family is everything. My lovely and amazing husband Michael has been so supportive of this life I have chosen. He has listened patiently (and impatiently!) to my hours of ranting about road safety, the stress of this work, the thankless nature of it, as I am sure anyone working in this field will agree with! However, he was always there with the coffee and a hug and what more can you want! Finally, but most importantly my mother Mary. We lost her on June 15th so very suddenly. Her 80th birthday was on the 26th of October, a few

days ago. She should have been sitting here surrounded by heartfelt congratulations from her myriad of friends, a blow-out party in my house…a milestone she so was looking forward to. I have to force myself to not be selfish and think she's happy now with Daddy who we lost in 1996. Margo said to me that no matter what age you are when your mother dies, you have lost the most important person in your life, the person who has formed you, your anchor. I am so sad that she did not live to see me get this work across the line, that I can't share with her the pictures of my graduation or let her call me Dr Martin with pride - as she so longed to do. I miss her so much. Life is full of regrets, and mine is not spending enough time with her while I had her.

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Chapter 1 Introduction

Section 1.1 Introduction

According to the European Transport Council (2022) each day in the European Union, more than eighteen children are seriously injured, and one is killed in road traffic collisions. More than 6,000 have died over the last decade. Children are particularly vulnerable road users; however, these numbers of deaths and injuries are not inevitable. Over the last decade child road mortality (the number of road deaths per million child population) has declined, and at a faster rate than the road mortality of the rest of the population. According to the most recent figures from the RSA in Ireland, between 2014 and 2022, of 908 children killed or seriously injured, half (51%) were pedestrians. Two in three (67%) of child casualties were injured on urban roads with a speed limit of 60km/h or less. Each year since 2014 there have consistently been higher numbers of males than females injured (77% of male child casualties were vulnerable road users, compared to 60% of female casualties). Six in 10 of all children seriously injured were aged 10-15 years (60%), and over half of children killed (55%) were aged 10-15.

These figures clearly indicate the need for better understanding of how and where to intervene to improve road safety for children. Realistically, it can only be achieved through a combined effort to address the behaviour of all road users, upgrading the road environment, designing vehicles that better protect both their occupants and those outside the vehicle, enforcing traffic laws, improving road traffic education and awareness raising. However, while some of these are outside the control of families who want to let their children walk independently and safely around their local communities, there is the potential to empower parents to help their children positively increase their skill and perceptions of risk when out around their roads. It is important therefore, to identify both the safe and unsafe behaviours of children on our roads and try to determine what are the antecedents of such behaviour with a view to trying to improve them in the future.

Section 1.2 Study Aims

Causes of road collisions are complex and involve several factors, including road user behaviours (pedestrian, cyclists, drivers' behaviour), traffic (volume, speed), road infrastructure (safety measures, conditions of the road), and other environmental issues (weather). To effectively reduce the rates of collisions, each of these have an intrinsic part to play, however, the focus of this study is on road user behaviour, in particular younger adolescents, and children. There is a considerable amount of literature dedicated to younger and older adult pedestrian safety and the investigation of collision causing factors. However, there is significantly less focus on adolescents, specifically younger adolescents aged 11 to 12, who are at the stage of increasing independence, leaving a gap in creating appropriate strategies to increase this populations road safety. The aims of this study are:

- develop a valid and reliable self-report road safety tool for children aged between 11 and 12 years in Ireland,
- gain a better insight into the road use behaviour of Irish primary school children aged between 11 and 12 years,
- assess their road safety beliefs and attitudes,
- assess their perception of risk and
- assess how that relates to their parents' perception of risk and parents' perception of their child's road use behaviour.

Section 1.3 Investigating Influences on Child Pedestrian Behaviour

There are several themes consistent across the literature highlighting factors which impact child pedestrian safety compared to adults. For instance, children are more vulnerable to collisions than adult pedestrians as they lack the necessary cognitive skills relevant to safe pedestrian behaviour (Schwebel et al., 2018), their smaller physiques make children more vulnerable to severe injuries and make them less detectable from roadside obstructions (Stevenson et al., 2015). Further difficulties relate to age and gender differences with young males taking more risks than females (Wang et al., 2018), teenagers and children at greater risk when distracted due to increased mobile phone use and less experience with traffic (Ferguson et al., 2013), prefrontal cortex maturational lag leading to disinhibition and sensation seeking'(Wang et al., 2019), the influence of peers and parents (Tolmie et al., 2009) and the local environment (Gris´e et al., 2018). Overall, the literature demonstrates that child pedestrian safety is a unique and challenging area to understand. These areas will be considered in more detail in the following sections. It is important to note that the terminology and age classifications are not consistent within research. For instance, some research papers refer to those aged 5 to 15 as children whereas others refer to those from 11 to 12 as young adolescents. Where relevant, the age being discussed will be clearly stated. The purpose of this section is to identify areas where children aged between 11 to 12 differ in their ability to cross the road safely compared to older adolescents and adults. In some instances, it will be necessary to refer to research involving younger cohorts as more research has focused on children under and including the ages of 11 years (5 to 11 years).

Section 1.3.1 Age Related Cognitive and Perceptual Skill in Young Adolescent Pedestrians

Young adolescent pedestrians require several cognitive and perceptual skills to navigate the traffic environment safely. Street crossing is a particular challenge for people of all ages as it involves a combination of hazard perception, visual searching ability and safe judgement and decision-making skills. As a result of deficiencies in these areas, research has indicated children are less skilled in crossing the road compared to adults, due to their poorer ability to 'read' roads in anticipation of future events. In particular, the younger children are, the greater their relative inability to correctly perceive potential danger, however road-crossing performance improves with age (Barton & Morrongiello, 2011; Meir et al., 2013, 2015a; 2020; Tabibi & Pfeffer 2007**;** Tapiro, et al., 2018; Tolmie et al., 1998). However, while it may improve with age, this research indicates that they do not reach adult level skill until over the age of 12 years, closer to 14 years.

Research on the behaviour of child pedestrians at different ages (5 to 16 years), including how they cross or walk along roads or streets, have used either self-reports, interviews or observation. Specific to the age group in this sample, studies using the adolescent road users questionnaire (ARBQ; Elliott & Baughan ,2004) to assess 11 to 12-year-olds along with older adolescents (Elliott & Baughan, 2004; Sullman et al., 2012; Wang et al. 2019), found this population performed the safest on the road compared to the 14 to 16 year olds reporting less unsafe crossing, less dangerous play (apart from Belgium, Sullman et al., 2012) and more planned protective behaviour. However, only the Chinese study included children under 11 and their study found the 11 to 12-year-olds performed significantly more unsafe crossing than the 10-year-olds. Importantly, across of the studies that examined age as a factor (10 to 19 years) unsafe road crossing behaviours increased with age across the UK (Elliott & Baughan, 2004), Spanish (Sullman et al., 2011), Belgium (Sullman et al., 2012), Iranian (Nabipour et al., 2015) and Chinese studies (Wang et al. 2019). Dangerous play on the road increased withage in the UK, Belgium and Chinese studies, but decreased in the Spanish research. Planned protective behaviour was higher in the younger age groups in the UK, Spanish, Iranian and Chinese research but lower in Belgium and New Zealand (Sullman & Mann, 2009).

Results from an extensive study carried out by Gitelman (2019), observed 2,930 children's behaviour at three types of crossings (signalized, un-signalized and with divided roads). The results indicated that the probability of crossing on red is higher for older children (over the age of 9), and particularly for adolescents, gender and distractions did not appear to affect behaviour. These studies suggests that children in the 11 to 12-year-old age category are beginning to demonstrate more risky behaviour that will continue into later adolescence. Unfortunately, developmentally, they will be less likely to be able to cross complex traffic situations safely compared to those children who are over 14 years of age, thereby making them particularly vulnerable due to their increasing independence, unsupervised on the road.

Perceptual information around oncoming events is important for guiding decisions about when and how to move in real-world action situations. According to Gibson (1979), perception of the environment inevitably leads to some course of action. When a living object moves through the environment, the information specifying their relative position with respect to other objects will change. The way this information changes over time provides 'affordances, or clues in the environment that indicate possibilities for action. According to Craig and Watson (2011) these affordances are the basis of action-decisions when certain environmental conditions afford a certain action. Relevant to the field of road safety, road-crossing is a perceptual-motor task where age has been shown to be a strong predictor of risk due to errors in action-based decisions. As cited in Stafford et al. (2022) research which involved making action-based decisions in relation to fast-moving objects like motor vehicles in the environment has shown that 'affordance perception' continues to change and develop even in late childhood and early adolescence (Chihak et al., 2010; Plumert & Kearney, 2018). This demonstrates the need to examine how age related difficulties in affordance perception change and develop across children's road use experience.

Plumert and Kearney (2018) suggested that road-crossing is a model system for studying dynamic affordance perception due to its being composed of the three components involved in action decision-making: selection of a sufficiently large gap (action selection), entering the gap behind the lead vehicle but sufficiently ahead of the tail vehicle (action initiation), and reaching the opposite sidewalk before the tail vehicle reaches their line of crossing (action control).

Research examining how children match their gap decisions and crossing actions has focused on how child cyclists cross roads, using an immersive, interactive bicycling simulator. Chihak et al. (2010) asked 10- and 12-year-old child and adult cyclists to intercept (occupy) moving gaps on the run in an immersive, fixed-base bicycling simulator. The conditions were manipulated so that participants needed to speed up or slow down to intercept the gap. They found that children had less time to spare than adults when they passed through the gap.

According to Barton and Schwebel (2007) children between 7 and 14 years old are better than younger children aged 5 to 6 years at focusing on simultaneous information from multiple sources to facilitate pedestrian crossings and realistically estimate the risk better. They suggest that by age of 11, children have a relatively good spatial orientation, their perception of sounds is fully developed, and their field of view is also increasing. However, when compared older children (15–18 years old) and adults, they react more slowly and are also less competent at judging the speed, distance, and acceleration of multiple vehicles from multiple directions, as well as the speed at which they can physically cross a pedestrian crosswalk. A main factor to consider however, is that according to research, younger children tend not to look at gaps at all, concentrating instead on individual vehicles, the vehicle's model or colour, rather than on relevant variables, such as its speed, distance, or direction of travel (Tolmie et al. 1998)

In general, research on the influence of vehicle speeds and distances on children's crossing behaviours indicates that vehicle distance is used more often than speed by children judging traffic safety. A study by Simpson et al. (2003) investigated pedestrian behaviour among children (5–9 and 10–14 years old), adolescents (15–19 years old) and adults (above 19 years old) in a virtual traffic environment. Vehicles travelled either at a uniform distance apart or at a uniform speed. The study results suggested that pedestrians of all ages, based road crossing decisions on distance more than vehicle speed. Research by Morrongiello et al. (2016) and Oxley et al. (2005) reported similar findings. According to Connelly et al. (1998) while both the speed and the distance of a car affect the ability to safely navigate through inter-vehicle gaps, pedestrians aged 5–12 years seem to rely more on vehicle distance than speed during gap selection.

Judging the time to cross multiple lanes of traffic is particularly challenging because the gaps (which cannot be viewed simultaneously) approach from opposite directions. Slower decision making can have serious consequences as according to Plumert and Kearney (2014) time spent judging the ability to cross one gap takes away from time available to judge the next gap. There must be sufficient time to carry out actions following a decision to cross, and the action of crossing must be initiated at the right time as errors can result when the window for action is too tight or when the timing of action is insufficiently precise (or both).

To investigate pedestrian gap preferences when faced with multiple lanes of traffic, Grechkin et al. (2013) monitored 12- and 14-year-olds and adult gap selection while crossing through a series of 12 intersections in a bicycling simulator. These researchers suggest that when faced with multiple lanes of traffic, two types of scenarios can emerge. When the far gap opens before or with the near gap, the window for action appears as a single "aligned" gap spanning both lanes of traffic. On the other hand, in a "rolling" gap, the near-lane gap opens before the far-lane gap allowing pedestrians to begin crossing before the far-lane gap has opened. They found that all age groups exhibited a preference for rolling over aligned gaps, despite its difficulty as it gave them more time to cross. They noted however, children had significantly less time to spare than adults when they crossed an aligned gap. This would most likely be the expected choice for a younger pedestrian in a roadside context as otherwise, they are entering the roadway while traffic is still oncoming on the far side of the road. Therefore, in situations like this, their option is seeing a full gap and going for it or start to cross while traffic is oncoming and hoping to get across fully without having to turn back as the car on the far side is coming faster than they thought. This is why it is safer for children at this age to used controlled crossings to avoid a near-miss or collision.

Following on from this research, Plumert and Kearney (2011; 2014) have consistently reported that 10- and 12-year-old children choose the same size gaps as adults but end up with less time to spare when clearing the path of the approaching car, largely because children time their entry relative to the lead car in the gap less tightly than adults. The fact that 10- and 12-year-olds do not compensate for their less precise timing of entry by choosing larger gaps suggests that their ability to coordinate decisions and actions when cycling across roads is still undergoing developmental change well into adolescence. Therefore, it appears that decisions and crossing actions by children up to the age of 12 are not as well matched as those of adults.

However, one limitation of this research is that it has focused on cycling which children have far less experience compared with walking. Research by O’Neal et al. (2018) focused on six to 14-year-olds and adults road crossing with a large-screen, immersive pedestrian simulator. They found younger children were less discriminating than older children and adults, choosing fewer large gaps and more small gaps. However, 12-year-olds’ gap choices were significantly more conservative than those of 14-year-olds, and adults. The timing of entry behind the lead vehicle in the gap (a key measure of movement coordination) did not reach adult like levels until the age of 14 years. This would appear to support the findings from the cycling studies. However, more recent research by Stafford et al, (2022) investigated age differences between three age groups (Children: 10–12 years old; Adults: 19–39 years old; Older Adults: 65 + year olds) in the use of perceptual information for selection, timing, and control of action when crossing a two-way street in an immersive, interactive virtual reality environment. They found that action initiation and control were similar for children and adults which showed a strong ability to precisely time their entry with respect to the lead vehicle. This maximised the available time to cross and coordinate walking movements with the tail vehicle to ensure they would not collide with traffic. Despite this finding, the other research to date had been consistent with regard to the lesser ability of children up to the age of 12 to be able to effectively judge and act on a gap when attempting to cross a road.

The differences observed may be due to the newer technology either improving the testing environment by making it more realistic or, alternatively making it appear more like a video game/VR experience where the aim is to move with speed and win without the negative consequences and fear which may be present in a real-life situation. The fact that there was such a marked difference with the population over 65 years may suggest younger peoples' experience and expertise with gaming and VR may be having an impact, over and above the normal cognitive decline associated with natural aging. However, based on the majority of previous research, it would appear two- way street crossing is particularly dangerous for children, as they tend to show poorer decision-making during the process (Leung et al., 2021).

Regarding hazard perception, research tends to distinguish between materialised and unmaterialised road hazards. Materialised hazards refer to situations that may require an evasive response (avoid a collision) whereas hidden unmaterialised hazards are potential sources of danger that are usually obscured by objects or other road users. For example, a pedestrian may be blocked from view behind a parked car, but they did not cross (Borowsky & Oron-Gilad, 2013). A key difference between adults and children is that adults tend to identify both materialised road and unmaterialised road hazards whereas child-pedestrians tend to identify mainly materialised hazards and are poor at identifying unmaterialised road hazards (Meir et al., 2013; 2015; 2015). Building on this earlier work, Meir et al. (2020) examined adults and 7–13-year-olds pedestrian hazard perception (HP) skills in complex traffic scenes. Across two studies, findings revealed that adults tended to rate photographs depicting field of view partially obscured by parked vehicles as more hazardous and they tended to rate photographs depicting vehicles closer to the crossing site as more hazardous. In a dynamic simulated environment of an urban road, they also examined a crossing decision task where participants observed traffic scenes from a pedestrian's perspective and pressed a response button whenever they assumed it was safe to cross. Compared to experienced-adults, 9–13-year-olds presented a less decisive performance. Once again, they were found to be slower in reaching the decision to cross.

A final factor to consider is the impact of personality differences where research has indicated that participants' sensation seeking tendencies affect crossing behaviour. Unlike the development of cognitive-perceptual skill, which progressively develops as children grow older, the sensation seeking is linked to pubertal maturation and follows an inverted u-shaped function. Zuckerman & Kuhlman, (2000), describe sensation seeking tendencies as a desire for and action toward varied, novel, exciting, complex, and intense experiences and feelings. It is suggested that these sensation seeking tendencies typically remain 'fairly flat' in early childhood but increase between age 10 and 15 before declining or remaining stable through late adolescence and early adulthood (Steinberg et al., 2008). Sullman et al. (2012) investigated sensation through the Sensation Seeking Questionnaire for Children (Morrongiello & Lasenby, 2006). They found that those with lower levels of thrill-seeking behaviour were less likely to engage in unsafe crossing and dangerous play on the road but were also less inclined to engage in planned protective behaviour. Further, those with low behavioural inhibition were less likely to engage in planned protective behaviour and more likely to play on the road and demonstrate unsafe crossing behaviours. Similarly, recent research has demonstrated that 10–13-year-olds low in sensation seeking missed more opportunities to cross and had longer starting gaps before entering the roadway compared with those high in sensation seeking. These effects were more substantial when the traffic condition was less demanding, with vehicles spread further apart and travelling more slowly (Wang et al., 2020, Wang et al., 2022).

Section 1.3.2 Gender Differences

The findings on gender differences in children has been mixed, with more focus generally on age. Across the road statistics, males are more likely to be killed or seriously injured than females and are overrepresented in the younger age groups in particular. Historically, research has explored differences between both genders in risky behaviours and danger appraisal during childhood and found no matter the age males tended to have more risky attitudes, to be less afraid of danger, be more confident of their ability to cope with danger, and have greater comparative optimism when facing collision risks than females (DeJoy, 1992; Harré et al., 2000; Peterson et al., 199; Rosenbloom and Wolf, 2002; as cited in Granié, 2007). However, safe behaviours on the road depend on more than just attitudes toward risks and the ability to assess road dangers. They also need to take into account the formal and informal rules that govern social interactions on the road (Björklund & Aberg, 2005). Previous research on compliance in the adult population has shown that male pedestrians violate more rules than female pedestrians (Moyano Diaz, 2002) and males expect fewer negative outcomes of traffic violations than females (Parker et al.,1992).

In their study of rule compliance and risk taking in children, Morrongiello and Dawber (2004) indicated that girls complied more than boys with maternal requests to avoid approaching a dangerous object, and that children's perception of parental norms about risk-taking were considered much more by girls than boys when they had to choose between three more or less dangerous routes. Granie (2007) investigated pedestrian rule compliance in preschool children and found that girls' behaviours were more compliant than those of boys. However, boys were better than girls in looking at the surrounding environment before crossing. Girls were more compliant with rules, had better knowledge of rules, and exhibited greater rule internalisation than boys. Therefore, at an early age gender appears to have an influence on the compliance with traffic rules.

When assessing the impact of gender across the various studies utilising the ARBQ (Elliott & Baughan, 2004), differences remained relatively stable across each country with males more likely to engage in unsafe crossing than females in the UK, Belgium, Spain and China, but none were observed in New Zealand or Iran. Planned protective behaviour was higher in females in the UK and Chinese studies, however, in the Iranian sample, males reported more planned protective behaviour. No gender differences were reported in Belgium, Spain, or New Zealand. For dangerous play on the road, males performed this behaviour more often in UK, Spain, Belgium, New Zealand, Iran and China., This demonstrates within studies using the ARBQ, males behave in a riskier manner than females, and that unsafe behaviour tends to increase with age.

Holm et al. (2018) investigated the road crossing of 1033 sixth-grade students with a mean age of 12.77 (0.38). The results showed that compared to girls, boys took significantly more risks as pedestrians as they often crossed the road against the red light and rarely used reflectors during periods of darkness. The research also suggests the *way* that children behave in risky ways as pedestrians, include failing to watch traffic before or while crossing (Rosenbloom et al., 2008; Zeedyk et al., 2002) is important to consider. Barton and Schwebel (2007) confirmed that among the observed children, girls waited longer than boys and attended to traffic more than boys who missed fewer opportunities to cross than girls and engaged in more anticipations than girls. The only gender difference found by Fu and Zu (2016) was that boys were more likely to run across a pedestrian crossing than females. Simeunovic et al. (2021) measured the speed of children aged 7 to 15 engaged in different walking regimes (Slow walk, Normal walk, Fast walk, Run and Rush) and found the impact of gender exists to a lesser extent at younger ages and becomes moderately significant at older ages. For ages 7 to 8, male children were faster only in the “rush” regime while for ages 8 to 10, female children were faster in the “fast” regime and male children are faster in the “rush” regime. However, for ages 10 to 12, male children were faster in two regimes: “fast” and “rush.” With the 12 to 15, male children were faster in three regimes: “fast” “run,” and “rush.” This demonstrates an increase in speed as males get older which may significantly impact observational ability and leaves more opportunity for errors. By way of explanation, positive attitudes towards risky behaviour as a road user could increase children’s risk-taking levels in traffic as indicated by Evans and Norman (2003). Interestingly, Papadimitriou (2013) studied patterns of pedestrian attitudes, perceptions and behaviour in Europe across 19 European countries involving 4290 pedestrians and found that males and young pedestrians are over-represented in ‘negative behaviour and attitudes’. Therefore, this behaviour would appear to persist from at least 10 years of age.

Section 1.3.3 Distraction

According to Tapiro et al. (2018) pedestrians of all ages are subject to an increasing number of stimuli and distractions from the roadside environment. To cross safely, pedestrians must shut out aural distractions including road noise, visual distraction such as advertising, and avoid engaging in activities such as mobile phone use, which can lead them to miss critical information within the traffic environment (Nasar et al., 2008; Schwebel et al., 2012; Tapiro et al., 2016).

Thomson (1996) stated that detecting the presence of traffic as a pedestrian involves visual search, focussing of attention on relevant information, counteracting distractions, auditory localisation and co-ordinating visual and auditory information. Therefore, the development of attention is very important for all aspects of road-crossing judgements. However, children aged 9 to 11 have limited attentional skills that are still being developed across this age range, putting them at greater risk relative to adults when they attempt to cross a road distracted (Doyle, 1973) These attentional skills can be regarded as four distinct, but, cooperating functional systems, as there are selective attention (the ability to attend to relevant stimuli and ignore a powerful competing distractor), sustained attention(maintaining vigilance to respond in the absence of external cues), the capacity to switch attention(the ability to engage, move and disengage attention in space) and divide attention (the ability to allocate attention efficiently to different tasks). Children's lesser abilities to maintain and orient selective attention over an extended period of time have been reported to impair road crossing performance (Barton, 2006; Tabibi & Pfeffer, 2007). Dunbar et al. (2001) found that children who were 'less reckless' at crossing a road were those who were able to maintain concentration when challenged by a distracting event. They also suggested switching attention from one task to another, or from one location to another, may be essential for pedestrians, for example when vehicles are approaching in different directions. Their research found that children who were better at switching attention were more likely to show awareness of traffic when crossing a road. Attentional skills are believed to continue to mature into early adolescence (Tabibi & Pfeffer, 2007), in theory, through improvements in information-processing speed (Kail, 1991) and improvements in mechanisms of attentional control such as the ability to inhibit irrelevant information (Dempster, 1992). Therefore, attention skills are not yet at adult level in the age range 11 to 12 years putting them at increased risk to allocate attention to different aspects of a complex road environment and make decisions on where and when to cross a road. The increase in the level of distractions to pedestrians has further challenged safe road crossing in the younger age group, not least of which is mobile phone use.

Pedestrian distraction has become an emerging safety issue as more pedestrians use their smart or mobile phones while walking and crossing the street (Scopatz & Zhou, 2016). A meta-analysis by Simmons et al. (2019) identified more than 50 experimental and observational studies investigating the effect of distractions on pedestrian walking and street crossing behaviour. However, very few of these involved children and young adolescents (< 15 years old), therefore, an examination of how mobile phone distraction impacts pedestrian behaviour will need to focus more on research published on young adults aged 18 and over. The developmental differences in children compared to adults needs to be considered when assessing how compelling the evidence is for impaired pedestrian behaviour in young adults and how exactly it impairs functioning.

Research has indicated that walking while using a mobile phone led to visual, cognitive, and aural inattention, sometimes referred to as ‘inattentional blindness’which affects walking speed (Nasar et al., 2008) and causes more missed opportunities to cross (Tapiro et al., 2020). An observational study of 4196 pedestrians at four signalised intersections in China found pedestrians who used mobile phones committed more violations when crossing including crossing against red traffic lights (Zhou et al., 2019). The increase in smart phones with myriads of apps has further implications, as not only are people talking but they are interacting in several ways with the phone. As a result of this, a new term has been coined to describe the phenomenon of people walking around gaming or interacting on social networks while viewing their screens. Such individuals are known as “smombies” (combination of smartphone and zombies). As a result of this behaviour, a new scale ‘The Smombie Scale’ has been created that demonstrates good reliability and validity in measuring pedestrians’ smartphone use among young adults (Park & Kim, 2021).

Over ten years ago, Schwebel et al. (2012) studied students aged 18 to 45 in a virtual reality setting and found that pedestrians who sent text messages and listened to music were more likely to collide with virtual vehicles than pedestrians who were undistracted, but that pedestrians talking on the phone were not. On the other hand, using field observation methods, Pešić et al. (2016) found that talking on the phone impaired pedestrian safety the most, followed by texting. A recent study by Feld and Plummer (2019) compared visual scanning behaviour in 20 young adults aged between 18 and 30 when walking (single-task), walking while performing a letter-fluency task, and walking while texting. Visual scanning behaviour was measured by fixation count and dwell time percentage in specific areas of interest. Visual scanning behaviour differed between the three walking conditions. During dual-task letter fluency, participants demonstrated significantly more non-walking path fixations (more frequent, broader visual scanning) than either of the other two conditions. During dual-task texting, gaze was focused predominantly on the phone, with little visual scanning of the walking path and surrounding environment. When walking without texting or talking, gaze was directed equally to the walking path and surrounding environment.

Most recently, Wang et al. (2022) examined how visual and auditory distraction influenced pedestrian safety from two theoretical perspectives, increased cognitive load during distraction and resource competition within the same sensory modality. The results indicated that distracting tasks, like phone calls and text messages, impacted walking by decreasing its speed and increasing response time to traffic information thus supporting the work by Schwebel et al. (2012) and Tapiro et al. (2016). They also demonstrated that distracted tasks requiring a higher cognitive load increased the response time to traffic information indicating auditory distractions may impair pedestrian's processing of auditory traffic information like car horns while visual distraction diminishes processing of visual information like traffic lights. This is an important message as it means that not only are pedestrians distracted as they are looking down at their phones (which most road safety programmes focus on), but they are less aware of auditory cues. According to Schwebel (2013) there is compelling evidence that pedestrians use auditory cues to detect safety-related cues and they have gone on to develop a programme that uses Bluetooth beacon technology to alert and warn pedestrians when they approach intersections through both auditory and visual warnings on their smart phone, depending on the type of distraction present. Therefore, if a pedestrian is distracted by conversation or music, an audio warning is issued to encourage the pedestrian to attend to traffic; if their distraction is through looking at their phone, a visual warning is issued (Schwebel, 2020; 2021).

As the research has indicated such significant impairments in young adult pedestrian behaviour while distracted with a mobile phone, it is likely to be an issue for 11 to 12 years with deficits in attention capacity compared to adults. Relevant to the ability to identify safe crossing sites, Tabibi and Pfeffer (2007) investigated the influence of children's ages on the ability to recognise safe and dangerous road crossing points as related to age differences in attention capacity. This research indicated that the ability to identify safe and dangerous road-crossing sites increased with age up to age 10–11. They found no significant difference between the older children and adults in their ability to identify safe sites, however there was a significant difference in the time taken to identify them, with 10–11-year-olds taking much longer than adults in all conditions. If mobile phone distraction is included, the complexity of the situation increases. An early study by Stavrinos et al. (2009) involved 77 children aged 10 to 11-years-old who completed simulated road crossings in an immersive, interactive virtual pedestrian environment. Children crossed the virtual street six times while undistracted and six while distracted by a mobile phone conversation with an unfamiliar research assistant. The results indicated that while distracted, children were less attentive to traffic, left less safe time between their crossing and the next arriving vehicle, experienced more collisions and close calls with oncoming traffic, and waited longer before beginning to cross the street. Ferguson et al. (2013) observed 34,325 instances of teens crossing streets in school zones and found that about 1 in 5 high-school and 1 in 8 middle-school students were distracted. Texting and wearing headphones were the most frequently observed activities (39% each) followed by talking (20%) and playing games (2%). That study was ten years ago, and we know that with each year that passes, younger and younger children are being observed on mobile phones while travelling to and from school.

More recently, Tapiro et al. (2018) studied the responses of 52 children (aged 7–13) and adults who viewed 20 simulated crossing scenarios, embedded with visual and auditory (mobile phone calls) distractions. Participants had to determine when it was safe to cross the virtual road and immediately react by pressing a response button. They found that age was a significant positive factor in all tested measures of crossing: response time, safety gap, missed opportunities, and initiate crossing, as well as in the visual attention measure. The 11- to 13- year-old children demonstrated very similar road crossing behaviour to adults, as expressed in the safety gap measure and the visual attention distribution, which might suggest they can cross the road by themselves. However, an important difference was that they behaved like younger children aged 7–10 in their slower response to a crossing opportunity. As it was set out earlier in this section, this time delay entering the road can have severe consequences. Therefore, the combination of increased attentional demands and less experience with traffic places young adolescents and children at greater risk when distracted.

Morrongiello et al. (2021) used a fully immersive virtual reality system to assess children’s street crossing behaviours when they had auditory-based information about traffic and when they lacked auditory information. The lack of traffic sounds did not influence the inter-vehicle gap size that children crossed into, but it did result in slower initiations and, ultimately, more high-risk outcomes (close calls and hits). They concluded that traffic sounds significantly contribute to enhance children's safety when crossing streets. Cars with reduced sounds (e.g., electric) and anything that interferes with children accessing auditory-based traffic information, for example, wearing headphones could increase their risk of collision.

Another source of distraction is the presence of friends. On a daily basis, children aged 11 to 12, and young adolescents, frequently cross roads together including when travelling to and from school, attending after school activities and socialising independently at playgrounds and parks. According to O'Neal et al. (2019) crossing roads with others represents a particularly challenging task for children and adolescents, due to the increased complexity of joint decision making and the social influences on risk taking. Like mobile phones, most of the research on this form of distraction has focused on the older cohort (18 years and over). As cited in O' Neil et al. (2019), adult pedestrians were more likely to cross against a red light when others do, indicative of the flock mentality where people blindly follow the actions of others. Similarly, Zhou and Horrey (2010) indicated that people often follow other pedestrians when crossing the road, even if they are not convinced about the safety of doing so. Based on Gibson's 1979 theory, Jiang et al. (2018) studied how pairs of unacquainted adults cross a single lane of virtual traffic traveling from left to right compared to solo crossers. The task for participants was to physically cross a virtual road with continuous traffic without getting hit by a car. Participants performed this task either alone or with another person and it was found that participant pairs often crossed the same gap together and closely synchronized their movements when crossing. Pairs also chose larger gaps than individuals, presumably to accommodate the extra time needed to cross through gaps together.

Building on this research, O'Neal et al. (2019) examined how crossing roads with a friend versus alone affects gap decisions and movement timing in 96 young adolescents (12 years old) and adults. Using an immersive pedestrian simulator, the 12-year-olds and adults physically crossed a single lane of continuous traffic. Participants were instructed to cross the road without being hit by a car and completed 30 crossings either with a friend or alone. Friend pairs were not instructed to cross together. An important finding was that pairs of adolescent friends exhibited riskier road crossing behaviour than pairs of adult friends. For gaps crossed together, adult pairs were more discriminating in their gap choices than adult solo crossers, crossing fewer of the smaller gaps and more of the larger gaps. However, 12-year-old pairs compared to 12-year-old solo crossers did not follow this pattern. The pairs of 12-year-olds adjusted their movement timing by entering and crossing the road more quickly to compensate for their less discriminating gap choices. Unlike adults, 12-year-old first crossers were significantly less discriminating in their gap choices than 12-year-old second crossers. The main conclusion was that compared to adults, young adolescents took riskier gaps in traffic when crossing virtual roads with a friend than when crossing alone.

Given this research, the impact of peer influences may pose a significant risk to road safety in early adolescence. Key areas of concern would be adolescents choosing to cross through the same gap together or choosing risky gaps that are too small to accommodate them at the same time. Adolescents may also misinterpret movement or verbal cues from friends, leading the first crosser to choose an unsafe gap for crossing. This requires a better understanding of the impact or influence of peers on pedestrian behaviour.

Section 1.3.4 Influence of Peers

Previous research has indicated that peer influence negatively impacts risk taking in adolescence. Developmental psychological theories of adolescent risk-taking typically define “risky” behaviour, as any behaviour that carries some possibility of a negative outcome, including health or social consequences (Romer & Khurana 2020). The dominant paradigm for understanding an observed increase in risk taking in adolescence is the Dual Systems Theory (Steinberg et al., 2008). According to the dual systems perspective, risk taking peaks during adolescence because ‘activation of an early-maturing socioemotional-incentive processing system amplifies adolescents’ affinity for exciting, pleasurable, and novel activities at a time when a still immature cognitive control system is not yet strong enough to consistently restrain potentially hazardous impulses (Shulman et al., 2016, p. 103). In this instance, adolescence can be classified as early (10–13), middle (14–17), and late adolescence (18–21). Risk taking due to these competing networks is elevated between the ages of 10 and 14 years, when the cognitive-control network is undergoing significant developmental change. According to Steinberg's dual-systems theory, peer presence increases activation of socio-emotional networks, resulting in increased risk-taking behaviour. However, by age 15 or so, adolescents perform as well as adults on tasks measuring logical reasoning, information processing, and risk perception but not on emotion-based tasks (Shulman et al., 2016; Steinberg, 2010).

While the research on peer influences in pedestrian contexts is limited, like mobile phone use, impacts can be extrapolated from other areas, such as the impact that peers have on children's risk decisions in play settings. For example, Morrongiello et al. (2013) demonstrated that the degree to which the child identifies with the model can influence imitation. However, even when the peer observer is unknown, just their presence has been shown to increase children's risk taking in play situations (Morrongiello & Sedore, 2005).

Babu et al. (2011) used a virtual peer to explore the effects of peer influences on child cyclists' road-crossing behaviour. Using an immersive bicycling simulator, 10- and 12-year-olds interacted with a peer cyclist that made either risky or safe choices in selecting gaps in traffic. The children who rode with a risky peer were more likely to cross intermediate-sized gaps than children who rode with a safe peer. In addition, children were significantly less likely to stop at the last six intersections after the experience of riding with the risky than the safe peer during the first six intersections.

Pfeffer and Hunter, (2013) asked participants (N = 80, 16 – 18-year-olds) to make pedestrian road-crossing decisions based upon 10 videos of road-crossing sites. Participants were assigned to one of four experimental conditions: negative peer (influencing unsafe decisions), positive peer (influencing cautious decisions), silent peer (who observed but did not comment), and no peer (the participant completed the task alone). Peers from the adolescent's own friendship group were recruited to influence either an unsafe or a cautious decision. The results found that participants more frequently identified dangerous road-crossing sites when accompanied by a positive peer, but least often when accompanied by a negative peer. Also, both cautious and unsafe comments from a peer influenced adolescent pedestrians' decisions.

A study by Rosenbloom (2102) compared the actual and perceived social norms regarding road crossing behaviours in a sample of 6 to 13-year-olds. Results indicated that the variables, perceived peers' attitudes and perceived peers' behaviours, contributed significantly to the outcome. The riskier the perceived peers' attitudes and behaviours with regard to road crossing, the riskier the child's own behaviour was when crossing the road.

Morrongiello et al. (2019) assessed if children aged 8 to 10 perception of peers' behavioural norms for crossing streets related to their personal norms for doing so and if children's self-reports about crossing were associated with their actual crossing in a virtual traffic situation. Children's perception of peers' behavioural norms for crossing related to their personal norms for doing so, and their norms related to their reports of how they crossed in the past few weeks. When crossing virtual streets, children with higher scores on self-reports about risky crossing behaviours selected smaller (riskier) inter-vehicle gap sizes to cross into, showed less start delay (less time appraising traffic before starting), and experienced more collisions. Therefore, children's perception of peers' behavioural norms for crossing are relevant to their crossing behaviours and may elevate children's risk when using the roads. A lesser considered factor is that of distraction rather than simply negative influence when being accompanied by peers. For example, Deluka-Tibljas et al. (2021) observational study at signalised cross walks on children aged 5 to 15 found that social interaction such as walking in pairs or in a group slows down young pedestrians when walking across streets, thereby making their crossing more dangerous.

To understand the influence of peers and how it impacts behaviour, several theories which relate to health decisions and cognition can be drawn on, the main ones being social learning theory and the theory of planned behaviour.

Section 1.3.5 Social Cognitive Theory Underpinning Risk and Decision Making

It is important to understand what psychological concept underpin some of the research that has been discussed. According to the Social-Cognitive Theory (SCT; 1986) which started as the Social Learning Theory (SLT) in the 1960s by Albert Bandura, learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behaviour; behavioural capacity (what to do and how to do it), and environmental factors, considering the observational learning ("modelling" behaviours), reinforcements (positive or negative, and internal or external), expectations (anticipated consequences of a person's behaviour) and the concept of self-efficacy, which refers to the own-confidence on the ability to successfully perform a behaviour.

According to Bandura's Social Learning theory (Bandura,1986), individuals learn behaviours by observing others and behavioural imitation is more likely when there are no negative outcomes or if there are positive outcomes for the behaviour. Therefore, children who do not experience negative consequences would be desensitised to expectations of future risk. From a road safety perspective, if children or young adolescents observe peers crossing streets in a risky manner and making it across safely, then they are more likely to imitate that behaviour. Morrongiello and Rennie (1998) provided empirical support for this hypothesis with a sample of 300 risk-taking children. They identified three characteristics of individuals that successfully differentiated risk takers and avoiders with over 80% accuracy. These factors included: appraisal of danger, beliefs about personal vulnerability for injury, and attributions for the injury (self, other, and bad luck). Children who rated the danger as high, perceived themselves as personally vulnerable for injury in the situation, and anticipated that injury would be attributable to their own behaviour were more likely to avoid risk-taking. In contrast, those who rated danger and perceived vulnerability as low and who anticipated that injury would not be attributable to their own behaviour more often endorsed risk-taking. Morrongiello et al's (2013) study on children aged 6 to 12 suggested that children are more likely to model the risk-taking behaviours of their peers if they do not experience injury consequences. According to social psychological theory, girls are socialised to be wary of risks whereas boys are socialised to be undaunted by potential risks (Harris & Miller, 2000). This may be evidenced by the greater likelihood of parents accompanying female children to school than males (Zeedyk & Kelly 2003).

Although often conceptualized as a rational cognitive process, risk perception does not necessarily occur in an emotionally neutral context. Threats of injury or harm often elicit uncomfortable cognitions and emotions including fear, anxiety, and worry. Hence, people minimize their risk of harm to avoid these thoughts and feelings. Therefore, according to motivational theory, risk judgments and negative cognitions are thought to be positively related. In the field of road safety, this may also be related the social learning principles which suggest children who experience, observe, or learn about others being injured or in danger while crossing the street, might develop fearful emotions surrounding street-crossing, leading the children to avoid or take caution when street-crossing. In a study among second, fifth, and eighth graders, Peterson et al. (1995) reported that the participants experienced fear and exhilaration in reactions to simulated risky play situations.

Wang et al. (2021) examined children's perception of fear in various traffic situations and the relationship between their fear perception and their decision as a pedestrian 150 children aged 6–12-years. Children reported greater emotional fear when they faced quicker traffic, shorter distances from approaching traffic, and red rather than green traffic signals. Children who were more fearful made safer pedestrian decisions in more challenging traffic situations. However, when the least risky traffic situation was presented, fear was associated with more errors in children's pedestrian decisions: fearful children failed to cross the street when they could have done so safely. Perception of fear did not vary by child age. They concluded that children's emotional fear may predict risk-taking in traffic. When traffic situations are challenging to cross, fear may appropriately create safer decisions. However, when the traffic situation is less risky, feelings of fear could lead to excessive caution and inefficiency.

Additional research suggested fearful individuals may take greater risks in traffic situations. Shen et al. (2015) found a relationship between temperamental fear and children's risky pedestrian behaviour in a virtual reality traffic environment. Here, fearful children were more likely to hesitate prior to crossing, entered and crossed within smaller traffic gaps and had increased risk of virtual collisions. Morrongiello and Matheis (2004) examined the contribution of cognitive and emotion-based factors in predicting school-age children's risk-taking decisions when the social–situational context did and did not create pressure for risk-taking. Using drawings of play situations that depicted three possible paths of travel that varied in injury risk and convenience, they explored children's appraisals of danger and injury severity (i.e., cognitive measures), and anticipated fear and excitement (i.e., emotion measures) for each possible path of travel. Children also indicated which path they would take and gave a justification for this decision. They were also informed of information that threatened loss of a desired goal unless one of the more convenient (faster), risky paths was selected. Children then repeated their path selections and the cognitive and emotion appraisals. The results indicated that when a situation pressured for greater risk-taking to attain a desired goal, children endorsed greater risk-taking the majority of the time, with convenience being the most frequently cited reason for this decision. Overall, both cognitive and emotion-based measures contributed to predict risk-taking decisions in both social–situational contexts. This has consequences for the negative impact of peers when crossing or playing along the road.

The impact of older siblings and peers on children's risk decisions has been confirmed in research by Morrongiello and Bradley (1997). After the appeals of older siblings, younger children significantly shifted their decisions: choices of less risky paths replaced the initial selection of more risky paths, and vice versa. A positive sibling relationship was predictive of younger siblings' decision changes. Boys and girls were equally effective in persuasion, but they did so utilising different types of arguments, with boys communicating primarily appeals to fun and girls emphasising appeals to safety.

Findings also reveal that school-age children are influenced by verbal (e.g., persuasive appeals) as well as nonverbal communications (e.g., facial displays). Moreover, the quality of the relationship mediates the impact of these communications on the child's risk-taking decisions, with children more likely to go along with risk-taking when they highly value the relationship as evidenced by Morrongiello and Dawber (2004) who examined factors related to risk decisions in the context of best-friend pairs. Children were individually shown drawings of play situations, with different risk-level paths depicted. They gave fun and danger ratings for all paths, indicated the path they would take and why, identified the choice their best friend would make, and which path each parent would want them to take. Subsequently, a peer-influence session was contrived in which their best friend attempted to persuade them to select another path. Greater experience with an activity was associated with greater risk-taking. Perceptions of danger negatively correlated with risk-taking decisions. For boys, fun ratings positively correlated with risk-taking decisions. Girls selected paths consistent with what they believed their parents would favour. Best friends were highly similar in risk-taking but when differences emerged, best friends were successful about 50% of the time in their persuasion efforts.

Rate of success positively correlated with friendship quality. These studies suggest that social–situational pressures for risk-taking can substantially influence children's decisions to engage in injury-risk behaviour.

Cognitive theory of risk perception also suggest that people have a pervasive tendency to perceive their risk of harm to be below average (Weinstein, 1980, 1984, 1989). Weinstein (1980) referred to this cognitive bias as unrealistic optimism because although some people's risk may be below average, it is unrealistic for everyone's risk to fall below average. It was further noted that children and adolescents are just as likely as adults to exhibit this bias; however, adults may show stronger biases. Self-serving biases about event-related skills, for example, can cause people to believe that they possess the necessary skills to successfully avoid health risk. This is supported by evidence of people exhibiting self-serving biases around driving skill in males and females (McKenna et al., 1991) and perceiving lower risks for events involving some element of personal control or error versus for random, unpredictable events (Greening & Chandler, 1997).

Although these previous theories suggest that individual, social and environmental factors can lead to the intention to perform a behaviour, intention does not always lead to behaviour. Previous research with adults has documented that decisions to engage in behaviours that individuals know to be risky because they pose some threat to health or safety are often associated with changes in cognitions to reduce cognitive dissonance and achieve a state of comfortable denial. The Theory of Cognitive Dissonance (Festinger, 1957) suggests that cognitive dissonance occurs when a person believes in thoughts, performs actions or consumes new information that conflicts with his or her attitudes, beliefs or behaviours. Human beings have a desire of avoid contradiction, so it is psychologically uncomfortable when an individual experiences inconsistency. Therefore, it is necessary to implement actions to reduce this dissonance. Morrongiello and Matheis (2004) reasoned that dissonance-reducing goals could also be achieved by finding ways to convince oneself that the benefits of engaging in the behaviour outweigh the costs. Therefore, if emotions also contribute to risk-taking decisions, then individuals may reduce dissonance by playing up the anticipated emotional benefits of their action (e.g., excitement or fun value), relative to the costs (i.e., possible injury).

Section 1.3.6 The Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB; Ajzen, 1991) is a rational decision-making model which attempts to explain an individual's intention to engage in a target behaviour. This model is an extension of the theory of reasoned action (TRA; Ajzen & Fishbein, 1980) and incorporates social and personal factors as predictors. The key component of this model is behavioural intent (motivation) which is determined by several potentially changeable cognitions, such as the attitude surrounding the likelihood that the behaviour will have the expected outcome and the subjective evaluation of the risks and benefits of that outcome (Murtagh et al., 2012).

Specifically, the theory proposes that intention is the proximal determinant of behaviour, and that this intention is an indication of how much an individual wants to perform such a behaviour and how hard they are prepared to try in order to perform it (Ajzen, 1991). Three constructs influence or determine the behavioural intent; attitude, subjective norm (SN) and perceived behavioural control (PBC). Attitude is either a positive or negative evaluation about performing the target behaviour (Elliott & Thomson, 2010). SN is based on normative beliefs (perceived social norm) about the extent to which important others want them to perform a behaviour and is influenced by the persons own motivation to comply with those beliefs of others. PBC is a person's perception of their ability to perform a given behaviour and is underpinned by perceptions of obstacles, impediments, skills, resources, and opportunities that may inhibit or facilitate performance of the behaviour (Quine et al., 2001). While PBC is thought of as an independent predictor of intention, it is also held to predict behaviour directly, along with intention, to the extent that perception of control is accurate (Ajzen, 1991; Sheeran, et al., 2003).

In accordance with the model, the more positive a person's attitude and desire to comply to with the perceived SN, and the greater their PBC regarding the target behaviour, the more likely the intent to perform that behaviour. Similarly, the stronger the intent, the more likely they are to perform the behaviour. However, it is important to note that whether a variable significantly contributes to the intention to perform the target behaviour, depends on the type of behaviour being assessed and the target population (Ajzen, 1991; Ajzen & Fishbein, 2005).

Specifically, the TPB has been used in the field of road safety to explain people's intentions and subsequent driving behaviours such as, the commission of driving violations (Castanier, et al., 2013; Forward, 2009; Moyano Díaz, 2002; Palat, et al., 2017) speeding (Cestac, 2014; Chorlton, 2012; Conner et al., 2006; Elliott et al., 2005; Forward, 2009; Lewis, et al., 2013; Lheureux et al. 2016; Paris & Broucke, 2008; Parker et al., 1992; Warner & Åberg, 2006) drink driving (Chan et al. , 2010; Moan & Rise, 2011; Rivis et al, 2011) drink driving and perceived invulnerability (Potard et al., 2018) texting while driving (Gauld et al., 2014; Gupta, et al., 2016; Prat et al. , 2015) mobile phone use (Gauld et al., 2014; Zhou, et al., 2012) overtaking violations (Atombo at al., 2016) driver distraction (Chen et al., 2016) driving while fatigued (Jiang, et al., 2017; Lee at al., 2016) seat belt use of car users (Okamura et al., 2012; Şimşekoğlu & Lajunen, 2008) risky riding (Chorlton et al., 2012) motorcycle speeding (Elliott, 2010) and helmet use in motorcyclists (Ghasemzadeh et al., 2017; Norris & Myers, 2013).

Several studies have also utilised TPB constructs and extended versions, to explain pedestrian behaviour such as risky crossing (Evans & Norman, 2003; Holland & Hill, 2007; Lennon, et al., 2017; Moyano Díaz, 2002; Zhou et al., , 2016; Zhou & Horrey, 2010) intentions to cross while distracted by a mobile phone (Barton at al. , 2016) drink walking (Gannon et al., 2014; Haque et al., 2012) intentions to jaywalk (Xu et al., 2013). Several researchers have applied the TPB to examine cyclists' behaviour such as predicting intention to cycle (Lois et al., 2015) predicting active school travel (Murtagh at al., 2012) and cyclist violations such as risky cyclist behaviour (Cristea & Gheorghiu, 2016) and e-bike rule breaking (Yang et al., 2018).

A breakdown of the models' components has shown attitude, SN, and PBC to typically explain between 39% and 61% of the variance in intentions (McDermott et al., 2015; Starfelt et al., 2016), while intention and PBC explain between 28% and 48% of the variance in behaviour in prospective studies. In particular, McEachan et al. (2011) reviewed over 200 studies that used the TPB to prospectively predict various health related behaviour and found that intention and PBC accounted for 19% of the variance in behaviour while attitude, SNs and PBC accounted for 44% of the variance in intention to adopt various types of healthy or risky behaviours. An earlier similar review of 185 TPB studies by Armitage and Connor (2001), found that attitudes, SNs and PBC accounted for

39% of the variation in intentions while intentions accounted for 31% of the variation in subsequent behaviour.

In research on vulnerable road users, Barton et al. (2016) found PBC to be the strongest contributor to the variance explained, accounting for 37%–49% of the variance in adult behavioural intentions when crossing. Crossing the road distracted by texting, listening to music, receiving a call or using an application on their mobile phone were included. PBC was the strongest predictor followed by attitude. Interestingly, participants had significantly more positive attitudes, SN, PBC and intentions for listening to music while crossing the road, compared to the other distractions. Lennon et al. (2017) reported that attitude, SN, and PBC significantly predicted intentions to use a smartphone while crossing the road, accounting for 62% of variance in Intentions for the entire sample, and 54% of the variance for eighteen to thirty-year olds. Attitude was the strongest predictor for both the whole sample (38%) and for eighteen to thirty-year olds (41%). Therefore, pedestrians with positive attitudes towards using their smart phones while crossing the road showed stronger intentions to do so. In addition, high mobile phone exposure was associated with stronger intentions to use a smart phone while crossing which may suggest high level of mobile phone use may lead to riskier behaviour, such as failing to stop use while crossing the road. Xu et al. (2013) examined pedestrians' intentions to jaywalk and found that the TPB accounted for 43% of the variance in behavioural intentions. Haque et al. (2012) utilised both a standard and extended version of the TPB, which included perceived risk, anticipated regret, and past behaviour to predict drink walking intentions in young people aged 17 to 25 years. The standard model explained 63% and the extended version 69% of the variance in intention to drink and walk, however, SN was not a significant predictor of drink walking intentions in either model. Similar to previous research, Zhou et al, (2009) found PBC to be the strongest predictor when examining conformity in road crossing situations. In follow on research with adolescents, Zhou and Horrey (2010) used two hypothetical situations based on conformity and non-conformity ideals. The TPB accounted for 30% of the variance in intentions in the non-conformity scenario and 40% in the conformity scenario. Once again, PBC was the strongest predictor in the conformity situation. Similarly, Holland and Hill (2007) assessed adults using four hypothetical risky street crossing situations and found the TPB accounting for 56–65% of the variance across all scenarios, with attitude being the strongest predictor.

Cristea and Gheorghiu (2016) used the TPB to examine cyclists' intentions to adopt risky behaviours in two scenarios. The TPB factors explained 49% of the variance in the intention to ride through a red light, and 65% in the intention to turn left at an intersection, with positive attitude and PBC as the best predictors. This confirmed previous findings (Castanier et al., 2013; Trafimow et al., 2002) and provides support for use of the TPB in understanding and explaining risky behaviours among cyclists. The research suggests that cyclists' positive evaluation of the situations and their judgement of the ease with which they could perform the behaviours, were the most important influencers on behavioural intentions. As in previous research, SNs were less significant in explaining behavioural intentions. Overall, studies of both walking and cycling behaviours have found that SN is consistently a weaker predictor of behaviour than PBC or attitude (Darker, et al., 2010; de Bruijn et al., 2009; Rhodes et al., 2007).

Overall, research on vulnerable road use behaviour in adults and adolescents has found the TPB to be capable of explaining between 30 and 65% of the variance in behavioural intention to engage in risky behaviour. PBC was found to be the most significant predictor and SN the weakest. Interestingly, research on risky driving behaviour suggested attitude and SN more significant predictors.

These findings align with McEachan et al. (2011) who suggest that the role of SN varies depending on the type of behaviour. Previous research had indicated SNs as the weakest predictor of intentions in applications of the TPB (Armitage & Conner, 2010; Godin & Kok, 1996; Hagger et al., 2002). Therefore, the type of behaviour is an important factor with both implications for the predictive utility of the TPB, as well as its potential for the development of effective interventions. Furthermore, whatever the type of behaviour being assessed, much of the variance for intention remains unexplained. An advantage of this model is its scope to incorporate additional variables of interest should they potentially enhance the predictive capacity of the model for investigating the target behaviour assuming they are theoretically justified (Ajzen, 1991).

It is important to note limitations. The first is the type of behaviour being predicted. In general, the efficacy of the model varies depending on behaviour type, but this is not a weakness in the model. Rather, Ajzen and Fishbein (1980) stated that variations in the size of relationships between constructs are likely for different behaviours and populations. However, an examination of these systematic variations is necessary to identify the relevance of the theory when developing interventions for behaviour change.

Vulnerable road user's decision to engage in risky pedestrian or cycling behaviours was more significantly predicted by PBC with SN the weakest predictor. Vulnerable road users, however, may overestimate their own ability or skill and so PBC becomes the stronger predictor. While PBC is thought of as an independent predictor of intention, it is also held to predict behaviour directly, along with intention, to the extent that perception of control is accurate (Ajzen, 1991; Sheeran et al., 2003). The weak predictor of SN in pedestrians and cyclists may be due to overlooking the potential importance of other social influences on behaviour apart from referent groups, for example, the perceived visibility of walking and cycling (Ball et al., 2010; Sahlqvist et al., 2015; Sarah et al., 2012). Therefore, the inclusion of visibility may benefit the model. This highlights the importance for tailoring road safety research and subsequent interventions based on the TPB to the specific behaviour or road user type. It also reinforces the importance of theoretical moderators to the TPB and the ability to incorporate additional variables of interest if such an inclusion will enhance the predictive capacity of the model.

An important consideration in the TPB is the type of norm included in the model. The SN is generally thought to comprise two related components: the descriptive norm refers to the person's perception of how often others in one's social network will perform the behaviour regardless of whether it is morally correct; injunctive norm refers to how much a person thinks that important social referents would want them to perform the behaviour (Cialdini, et al, 1990; Zhou et al., 2016). However, the most frequent norm used in the TPB is injunctive norms e.g., ''What I think others expect me to do" (Armitage & Conner, 2010). It should be noted that literature often does not differentiate between the two types of norms and may refer to either, depending on the study.

The contribution of SNs in the TPB has been controversial (Armitage & Conner, 2010). While SN reflects an individual's assessment of the likely approval or disapproval for their behaviour from a range of important others in their life, group norm represents an individual's belief that a specific referent group would approve/disapprove of their behaviour, as well as their perception of whether people in this referent group perform the behaviour (Terry & Hogg, 1996; White et al., 2009). Three relevant referent groups that likely influence a young person's decisions include friends, parents, and university peers (Borsari & Carey, 2001; Kuther et al., 2003; McGhie, et al, 2012). Research has indicated that friends (peer influence) can impact significantly upon a young person's decision-making and behaviour if he or she identifies strongly with the friendship group (Jamison & Myers, 2008; Johnston & White, 2003; Wood et al, 2004). For example, young people reported the highest intentions to drink walk in the company of friends who were also drink walking and crossing the road against the pedestrian traffic signal (McGhie et al., 2012).

Mobile phone involvement has an important influence on young people's intentions to use a mobile phone while walking or driving (Lennon et al., 2017; White at al., 2010; Walsh et al., 2011). In these studies, the group norms were included as an additional component based on previous research. Specifically, Walsh et al., (2008) and White et al., (2010) found that attitudes and pressure from significant others (injunctive norms) regarding the use of mobile phones, both calling and texting, while driving were significant predictors of a driver's intention to do so. Therefore, in future TPB studies on road users risk taking behaviour, it would be important to fully understand the target behaviour and population, so the most suitable norm or combination of norms is included.

Variables such as age and habit are likely to be important moderators. Research has suggested that adolescents, compared to adults, are less driven by rational considerations and more by affective influences such as impulsivity and direct social pressure (Gibbons et al, 2009; Hofmann et al, 2008). In this instance, attitudes may be less important and SN more important predictors in adolescent samples. The influence of habit on behaviour is relevant as according to the TPB behaviour is under a person's conscious control (Gardner et al, 2011; Kwasnicka at al., 2016). The lack of control over behaviours that are performed frequently and have become habitual may reduce the impact of intention to change as behaviours are more likely to be triggered and maintained automatically (de Bruijn et al., 2009). A meta-analysis by Ouellette and Wood (1998) reported that when a specific behaviour is practiced repeatedly and the context of performance is stable, past behaviour becomes a better predictor of future behaviour than intention. An earlier study by Verplanken at al. (1998) found intentions were only significantly related to a target behaviour when habit strength was weak. Therefore, an important question to be considered is the predictive ability of the TPB if the behaviour is already established to the extent, it has become a habit. This may be the case regarding mobile phone use while driving and walking as there may be a habitual component to such behaviour.

A final predictor is past behaviour. Past behaviour may influence variables within the TPB such as attitude or perceived control. It may be that a higher level of past behaviour could lead to less cognitively demanding inputs thereby impacting PBC. Haque et al. (2012) included perceived risk, anticipated regret, and past behaviour in an extended version of the TPB to predict young people's drink walking intentions. The extended TPB explained an additional 6% of the variance compared to the standard model. Research should consider the frequency and recency of past behaviour as separate or additional constructs.

The TPB has been used to explain adult and adolescent road safety behaviour but has not been applied to primary school children. However, it has been successfully utilised in children as young as 8 years to predict active school travel, physical activity and interacting with peers with ASD. For example, Freitag and Dunsmuir (2015) used the TPB to explore the attitudes, behavioural intentions and behaviour of 8 to 11-year-old primary school children towards peers with autism spectrum disorders (ASD). Children's attitudes, SN and PBC significantly predicted their behavioural intentions to befriend a peer with ASD. The strongest association was between PBC and behavioural intentions, but a significant association was found between children's behavioural intentions and actual behaviour. Wang and Wang (2015) used the TPB to examine the association between TPB variables and the moderate-to-vigorous physical activity (MVPA) of nine to thirteen-year-old children in China. Intention accounted for 9% of the variance in MVPA while attitude and PBC explained 33% of the variance in intentions to engage in MVPA. Murtagh et al. (2012)

successfully utilised the TPB to predict active school travel in children aged 8 to 9. The TPB accounted for 41 % and 10 % of the variance in intention and objectively measured behaviour respectively. PBC and both walking and car/bus habit independently predicted intention. Intention and car/bus habit independently predicted behaviour.

Therefore, the TPB has a very important role in explaining the impact of peer influence in the pedestrian risk in primary school children and indeed throughout their continued development through to adulthood. One of the key factors to consider is to include the group(s) most influential to the age group.

Section 1.3.7 Parental Supervision and Modelling of Behaviour

Adults serve as pedestrian role models and provide learning opportunities for children when walking either to school or for leisure. Adult supervision is considered a key behavioural technique for reducing child pedestrian involvement in accidents (Holm et al. 2018). According to Morrongiello and Barton (2007) adult supervision is defined as the physical proximity of the adult to the child. Supervision is deemed to affect the children's pedestrian safety as the supervising adult can intervene physically or verbally if the child behaves in an unsafe way. The form of supervision will differ depending on the age of the child. With younger children, holding hands (direct physical contact) can help adults restrain a child who may behave impulsively. With older children they can discuss road crossing and provide guidance. The efficacy of supervision has been demonstrated in several studies.

Morrongiello and Barton (2009) used naturalistic observations of parent–child pairs crossing at uncontrolled intersections and a short interview to examine parental supervision of children during crossings, modelling of safe-crossing behaviours, beliefs about how children come to cross streets safely, and whether child attributes (age, sex) relate to parental practices and beliefs. Results revealed that parents more closely supervised younger than older children, they modelled safer crossing practices for sons more than daughters, particularly younger sons, and although over half the sample believed children need to be explicitly taught how to cross safely, few provided any instruction when crossing with their children.

Riaz et al. (2021) investigated differences in crossing behaviour related to road infrastructure (i.e., one-way and two-way street, elevated and non-elevated street crossing), the gender of the child, and the effect of the accompanying adult's behaviour on the child's crossing behaviour. A total of 241 child–adult pairs were observed in Flanders, with children aged 6 to 12. More than half of the crossings exhibited two or more unsafe behaviours. Not stopping at the footpath before crossing was the most frequent unsafe behaviour, exhibited by 47.7% of children; not looking for oncoming traffic before and during the crossing was the second most frequent unsafe behaviour, exhibited by 39.4% of the children. The only difference between boys' and girls' crossing behaviour was in stopping at the footpath with girls 1.901 times more likely to stop before crossing as compared to boys. Adults holding hands of the child resulted in safer behaviours by children. The children not holding hands displayed significantly riskier behaviour in running or hopping while crossing the street and being distracted.

In general, research has indicated that parents usually model safe traffic behaviour for their young children. Zeedyk and Kelly's (2003) study which observed the behaviour of 123 adult–child pairs with children up to the age of 10 years as they crossed the road at pedestrian light-controlled crossings. Eight behaviours were coded, including whether or not the pair stopped at the footpath, waited for the light to change, and checked to ensure traffic flow had stopped. Results showed that the adults observed provided reasonably good models of pedestrian behaviour, but that they rarely treated the crossing event as an opportunity to teach children explicitly about road safety. There was no observed difference between men and women when accompanying children. The only gender difference to emerge revealed that adults were more likely to hold girls' hands than boys' hands. It appears that the gender of the child was a more influential factor than age of child. The authors suggested that adults perceive girls as being more in need of protection than boys.

A study by Pfeffer et al. (2010) investigated adult pedestrian behaviour when accompanying boys and girls in primary schools up to the age of nine years. Behaviours observed included stopping at the footpath, waiting at the footpath, looking left and right before and during road crossing, holding hands, talking, and walking straight across. The fewest safe pedestrian behaviours were observed at light-controlled crossings. The results found that adults behaved more cautiously when accompanying girls in comparison to boys, supporting previous research observations on British roads (Zeedyk & Kelly 2003).

Men displayed more safe behaviours when accompanying the older children and women displayed more safe behaviours when accompanying the younger children.

Apart from school time, children often walk on streets with their parents making these occasions another potential influence on children's pedestrian practices. Research (Morroginello et al., 2008) has indicated that children mostly model their own behaviour on parents' behaviour rather than their words. In addition, the older the children get, the more they copy their parents' behaviour, and children notice when parental safety practices are discrepant from what they are being taught. Researchers compared the impact of parent practices and teaching about safety on children's current behaviours and their intended future behaviours when they reach adulthood. Children's (aged 7 to 12 years) current behaviour was best predicted by parental teaching, however, how children planned to behave when they were adults was best predicted by parents' practices. Therefore, these results highlight the strength of family influences on children's adoption of safety and risk practices and support the notion of parental involvement in active road safety education.

Thomson et al. (2005) constructed a training program that addressed the conceptual and strategic issues involved in learning to cross through traffic gaps. Mothers (N 35) of the children in the schools volunteered to take part in the study. The roadside crossing judgments of children aged 7, 9, and 11 years were assessed relative to controls before and after training with a computer-simulated traffic environment. Trained children crossed more quickly, and their estimated crossing times became better aligned with actual crossing times. They crossed more promptly, missed fewer safe opportunities to cross, accepted smaller traffic gaps without increasing the number of risky crossings, and showed better conceptual understanding of the factors to be considered when making crossing judgments. All age groups improved to the same extent, and there was no deterioration when children were retested 8 months later. This was a strong indication of children's ability to learn from experience and that importance of enlisting parents as role models and capitalises on the strengths of the peer collaboration method with adults in improving children's roadside visual search (Tolmie et al., 1998; Tolmie, Thomson, & Foot, 2000).

Recently, building on earlier research on children's poorer ability to judge gaps in traffic and recognising the impact of parental modelling and supervision, O Neal et al. (2021) examined parental scaffolding of children's prospective control over decisions and actions during a joint perception-action task. Parents and their 6-, 8-, 10-, and 12-year-old children (N = 128) repeatedly crossed a virtual roadway together. The results found that guidance and control shifted from the parent to the child with increases in child age. With younger children, parents more often chose the gap that was crossed and prospectively discussed the gap choice. Greater use of an anticipatory gap selection strategy by parents predicted more precise timing of entry into the gap by children.

However, the opportunity to provide this modelling may be more relevant to the younger age group than the older children as Tabibi, et al. (2012) found that 11-year-old children often walk alone in traffic because parents have confidence in their ability to be more independent and evaluate risks. Morrongiello, & Barton (2009) found the majority of parents thought children are usually capable of crossing streets alone around ages 7–9. However, Barton and Schwebel (2007) found that children take more risks alone than with parents, while Evans & Norman (2003) reported that 72% of pedestrian collisions involving children occur at a time when they are alone in traffic. Inevitably, young adolescents do not walk on streets only with parents as they did in childhood but also with siblings, friends, teachers, other adults, and alone. It is difficult to ascertain from the current literature which group is the strongest role model for adolescents or whether, it is a combination of both.

However, according to Holm et al. (2018) the most important role models for adolescents in traffic behaviour are their parents. The role model behaviour with the strongest effect on adolescent high-risk behaviour in traffic is the role model who does not use crossings to cross the street. The results also showed that higher-risk traffic behaviour by adolescent pedestrians is predicted by higher-risk behaviour on the part of their companions such as parents, walking alone on the street, as well as by an adolescent's lower involvement in the less active prevention activities in the classroom.

Section 1.3.8 Parental Perception of Child Pedestrian Risk

Relatively little is known about how parental road safety attitudes are formed with the exceptions of work by Cloutier et al. (2011) who found that parent's gender (females), perceived primary source of danger, and sense of control were significant predictors of higher perception of risk in parents for their children. Research conducted by Lam (2000; 2001; 2005) found that parents recognised differential risk in pedestrian settings, and that fathers, parents of older children, and parents who work full-time, who have experienced injuries, tend to perceive roads as less dangerous for their children. Therefore, these researchers have emphasised areas where parental risk perception has been evidenced in road safety including the role of the environment, demographics, family mobility and cognitive factors.

For example, perception of risk around the volume and speed of traffic has been found to impact the mode of transport to school. Rothman et al. (2015) cross-sectional parent survey examined the associations between frequent walking to school (4–5 times/weekly) and parents' perceptions of traffic danger along the school route and at the school site, and between perceptions of high levels of school route traffic danger and social and built environment variables. The odds of frequent walking to school were 47% lower with high perceived school route traffic danger, but walking was unrelated to perceived school site traffic danger. This is supported by previous research indicating that concerned parents are less likely to let their children walk to and/or from school (Carver et al., 2010; Kerr et al., 2006; McMillan, 2007). Further, research indicates that the closer the school is, the less likely the parents are to be concerned about children's active commuting to school, in particular, if they are older (Seraj et al., 2012). Therefore, living in neighbourhoods with less traffic and a higher walkability can reduce parental concerns (Lam 2001; Kerr et al. 2006; Napier et al. 2011).

Other studies have explored the link between the "real" risk as measured in the environment and the perception of risk when researched. For example, Glik et al. (1991) maintained that a higher-risk environment influences risk perceptions where the risk becomes "invisible" to parents, lowering their perception of risk. In contrast, Gielen et al. (2004) claim that a high-risk environment fosters elevated risk perceptions, at least in less affluent neighbourhoods.

Random and Nordjaern (2013) investigated the relationship between risk perception and worry related to transport among the Norwegian population. They found that while risk is a cognitive construct and worry is related to emotions it is simultaneously associated with perceptions of risk. Therefore, if parents or caregivers are 'worried' about the overall safety in their area in terms of crime or higher instances of road traffic injury in their community, their overall risk perception may be elevated. A study on parental risk judgements and attitudes towards walking to school in Iran found that parents with high probability assessments of collisions and strong worry regarding pupils' accident risk while walking were less likely to let their children walk to school. However, parents with high safety knowledge were more likely to allow their pupils to walk to school. Glik et al. (1991) maintained that parents living in deprived communities seemed to be more aware of the risks for their children, which increased their perception of the risk to which their children were exposed. Similarly, Weir et al. (2006) noted an increase in traffic related concerns in deprived neighbourhoods in their sample. Christie et al. (2007) investigated parents of children aged 9–14 years living in lower socioeconomic areas. Results indicated that parents believe that children play in their local streets because there are few safe, secure, and well-maintained public spaces for children, and children are excluded from paid leisure activities because of their costs and insufficient parental responsibility. The key sources of risk identified by parents were illegal riding and driving around housing estates and on footpaths, the speed and volume of traffic, illegal parking, drivers being poorly informed about where children play and their own children's risk-taking behaviour.

In addition, other parental socio-demographic characteristics such as gender, education level, work status, and commuting patterns have been found to be associated with their children's travel mode to school (McDonald 2008a; Zhu and Lee 2009; Panter et al. 2010). Studies tend to show that women in general and mothers in particular have higher risk perceptions (Sellstrom et al., 2000). Harris and Miller (2000) demonstrated that mothers are more likely to have higher concerns about traffic volume, which in turn reduced the likelihood that their children walk or cycle to school. Morrongiello and Barton (2009) found that higher risk perception was correlated with greater supervision across all environmental conditions. Damashek et al. (2013) found that younger child age, child gender, higher levels of injury risk behaviour, and higher perceived risk of injury by mothers resulted in higher reported levels of supervision needed. Studies of parental escort behaviour consistently report that mothers are more likely than fathers to accompany children to school or activities (Schwanen 2007; Liu et al., 2012). When considering exposure, according to Zhu and Lee (2009), regular walking by parents positively correlates with children's walking to school while Martin et al. (2007) found that children are more likely to actively commute to school when their parents are physically active. Therefore, walking rather than using public or private transport may impact the level of exposure to the traffic and lower the overall perceived risk, particularly in mothers. Moreover, mothers who have a higher fear of crime and a lower sense of community are more likely to be concerned about the outdoor safety for their children (Prezza et al. 2005), which suggests that parents extend their own worry to their children. Holland and Hill (2007) used the theory of planned behaviour (TPB) to account for pedestrians' intentions to cross the road in risky situations and found men and women self-report different risk perceptions for pedestrian behaviours, while observations of the road crossing behaviour of men and women have found few differences. Yagil (2000) found that men are more likely to cross than women when a 'Don't Cross' signal is displayed. Women's perception of their susceptibility to an accident resulting from an unsafe crossing is higher than that of men; women also report more than men that they are motivated by normative (traffic laws) and instrumental considerations (perceived danger). These gender differences may have an impact on how they subsequently perceive risk for their children.

Cloutier et al. (2001) examined the impact on birth order on parental risk perception based on previous research but found no significant difference. However, other studies have suggested that the number of children in the household may influence parents' supervision of their children and have suggested that parents with more than one child may be laxer (Hao et al., 2008; Leong et al. 2001). Similarly, a study by Averett et al. (2009) found that having an older sibling decreased the likelihood of a child always having supervision. Therefore, the presence of an older sibling may have an impact on both the level of supervision the younger child receives and impact the younger child's level of risk taking. The impact of older siblings and peers on children's risk decisions has been confirmed in research by Morrongiello and Bradley (1997).

Finally, Cloutier et al. (2001) suggested cognitive processes have been shown to be linked to risk perceptions including past experiences, sense of control, and personal beliefs. Under social-cognitive theory, negative past experiences increase the perception of risk. Interestingly, Lam (2000) found that parents of families that had experienced an accident had significantly lower risk perceptions than other parents. Lam suggested a strong sense of control is generally expressed in lower risk perception on the part of this individual in road safety and elsewhere based on the concept that the person concerned thinks he/she can in fact "control" the risk situation. The sense of control has been confirmed many times as a predicator of risk perceptions, either by influencing behavioural intentions or by increasing the optimism bias (or the risk denial) related to perceptions (DeJoy 1989; Fischoff et al, 2000; Sjoberg, 2000; Vlek & Hendrick, 1989, as cited in Cloutier et al. 2011). Cloutier et al. (2011) also suggested the role of personal beliefs. These are considered to have an impact on risk perception as according to research (Finucane et al.2000; Greening et al.2005; Rundmo & Nordfjærn, 2013; Slovic and Peters, 2006) this affect or feeling of "fear" or "dread" to danger increase risk perceptions.

Therefore, the research indicates that parental perception of their children pedestrian safety risk is a complex combination of environment, demographic and cognitive factors. However, the key issue to consider is the impact that either high or lower parental perception of risks their children are exposed, can have on their children's mobility experiences and skill at navigating traffic safely. It may also impact their children's ongoing perception of risk for future modes of transport such as driving (either increasing or decreasing the risk perception. Therefore, a family culture of road safety has the potential to either positively or negatively impact a child's perception of risk and road safety across all modes of transport from early independent pedestrian and cycling behaviour to adult pedestrian cycling and driving behaviour.

Section 1.3.9 Road Safety Education

Road safety education can offer an important mechanism by which children can acquire appropriate age-related skills to interact with the road environment. However, this requires a broad understanding of how children acquire and implement new knowledge and skills, and necessarily involves input from a child's social and support network (Muir et al. 2017). School-based road safety education programmes aim to improve the road safety behaviour of children and adolescents. Given the many different types and forms of school-based road safety education programmes, it is important to understand which programmes are most effective. As part of their education strategy, the Road Safety Authority (RSA) in Ireland have developed a rage of material to educate primary school children about road safety. Relevant to this study, the children in primary schools were exposed to the 'Seatbelt Sheriff' aimed at 5- to 12-year-olds, 'Hi Glo Silver' aimed at 7- to 12-year-olds and an interactive demonstration called StreetSmart aimed from 5 years to 12 years. However, these are not mandatory and are at the discretion of the school to provide the materials and host the interactive StreetSmart programme. None of these programmes have a follow up and consist of either a desktop discussion of the materials by the schoolteacher, a poster competition, dance competition, or a one-off session with RSA trained staff which will last approximately one hour.

A review by Dragutinovic and Twisk, (2006) suggested that safety education should start as early as the age of 4-5 years and be continued through primary and secondary school. Group training should focus on interactions between children while adult-led learning and peer collaboration are powerful instruments because of the influence of social interaction on learning (model behaviour). Their review noted small stages of practical training are effective to form a concept based on action, supported by practice and developmental theories. However, they suggested classroom instruction by means of video or table-top models is less effective than behavioural training. Another review by Raftery and Wundersitz (2011) on the efficacy of road safety education in schools in Australia and internationally for the Centre for Automotive Safety Research in the University of Adelaide suggested the effectiveness of current road safety educational programmes remains largely undetermined as the available evidence is somewhat equivocal regarding the influence of RSE on road safety behaviour. They stressed that while there is little evidence showing that it works, there is a similar lack of evidence showing that it does not and for the most part current approaches to RSE do not cause harm and the value in passing on road safety knowledge should not be overlooked. However, the primary focus on these education programmes was on young drivers rather than pedestrians behaviour. These researchers have noted that using various methods of delivery have demonstrated an ability to stimulate, motivate, and engage students, which increases the likelihood that they will remain interested and attentive throughout the presentation, characteristics which are viewed as essential components of learning. They also stressed the use of experts should increase the credibility of the information, however this is dependent on the individual's perceptions of, and attitudes towards the expert in question. This is an important factor as within this age group, would peers be best paced to deliver information rather than 'older' less relatable professionals. They concluded that future development of RSE programs should be evidence-based and founded on established principles of best practice both for education and behaviour change. Finally, they emphasised the importance of well designed and implemented evaluations as there is little evidence demonstrating that such RSE approaches facilitate the transfer of knowledge into behaviour.

A recent systematic review by Akbari et al, (2021) found no evidence that RSE reduced collisions or injuries. Once again, this review was on pre driver education rather than pedestrian education at a younger age. The lack of available reviews on pedestrian safety education demonstrates the challenge in determining the importance of and the methodological rigour of road safety education programmes aimed at increasing pedestrian safety in primary school children.

There is, however, evidence from the literature that enlisting parents as educators has an important role to play. In a review of best practice principles for traffic safety education of young children, Elliott (1999) established the importance of parents and carers as road safety role models for their children and emphasised the opportunities for parents and carers to be primary trainers in road safety skills for their children. Therefore, understanding of the role of parents is required for optimal use in children's road safety. As demonstrated earlier in this review, parental modelling of safe crossing behaviour is an avenue by which they indirectly teach children about pedestrian safety. In the road safety context, role modelling and observational learning are important (Social Learning Theory). Reinforcement can increase the probability that children will engage in a certain behaviour; and parents who consistently engage in safe road user behaviour are more likely to transfer this knowledge to their children through observational learning. As children develop, their learning continues through experience and from demonstration and instruction by parents. Despite the important role that parents can play in their children's road safety education, there is limited evidence to suggest parents are aware of the key role they play in demonstrating road safety behaviours and teaching road safety skills. Further, for parents to become providers of road safety education for their children it is crucial that they have mastered the corresponding road safety knowledge and skills and understand what they should do and how to do it. Tolmie et al., (2005) suggested that adult guidance of children not only enhances the development of children's understanding but facilitates the application of their understanding across a variety of judgments, and children show significant generalisation after receiving parental guidance.

Muir et al. (2017) investigated 272 Australian parents' attitudes, knowledge and behaviours relating to their role in protecting and teaching their young children road safety skills. Participants had at least one child aged between 3 and 10 years. Most participants reporting that they restrict their alcohol consumption or do not drink at all while driving (98%), they drive at or below the speed limit (85%) and 'always' wear their seatbelts (98%). However, more than half of the participants reported engaging in distracting behaviours 'sometimes' or 'often' (54%) and only half reported never engaging in aggressive driving (49%). Only 77% believed they were their child's primary learning source for road safety skills with the remaining 23% believing school, friends or television were the primary source. Parents who felt they had a role to play in educating their children about road safety skills were significantly more likely to be educated at a university level or higher and were more likely to reside in metropolitan versus rural/regional areas.

In addition to social learning, other principles of mentoring by parents are important in teaching safety skills. In Australia, the Road Aware Parents programme was designed to teach parents road safety skills (WA Office of Road Safety, 2011), and an evaluation of the programme two years post implementation found significant improvements in parent reported self-efficacy to show, teach and practice road safety skills, as well as improvements in parental attitudes about road safety. Therefore, educating parents about the ways in which they can teach road safety skills may increase self-efficacy and enhance parental roles in teaching road safety.

Feng at al. (2022) in response to the question of how to improve the effectiveness of education, proposed many pedagogical theories that have been used for generations, one of which was the Constructivism Theory. Constructivists argue that knowledge is not acquired passively but through active communication, exploration and meaning construction with the help of contexts created by others and based on existing knowledge and experience. This theory emphasises the situational nature of learning, in particular that knowledge exists in specific, situational and perceptive activities, and conceptual knowledge is not an abstract entity independent of the situation but can only be truly understood through actual applied activities (Pande and Bharathi, 2020, Suwannaphisit et al., 2021 as cited in Feng et al. 2022). Put simply Feng et al. (2022) suggest that constructivism theory is a pedagogical theory with "situational learning" and "interactive teaching and multidirectional communication" as its core ideas and can provide a new guiding ideology for road safety training. Based on this approach, the selection of typical road hazard situations and active interaction with learners during road safety education may become an efficient way of training. Key to this is the important role that parents can play as the educators.

The current research on children's street-crossing interventions identifies two types: adults (such as parents and teachers) provide knowledge of safe pedestrian behaviour in children and the second is a virtual street environment so that they can participate in individual or group interventions in a simulated environment. Traditional traffic safety education focused on teaching children a set of crossing rules (Tabibi, 2009), such as the advice to be careful and to look both ways before crossing the street. To improve not only the participation of children in education but also the effect of interventions, Zare et al. (2019) proposed a road safety education method for children based on active learning theory with the participation of parents, which informed and improved children's street-crossing safety behaviours through parents' daily activities. In their randomized controlled trial, 149 children of seven years were selected from two male elementary schools in Iran. The participants were randomly assigned to two experimental groups, Active-Learning based training group and Active-Learning based training with Parental Involvement group and a control group (without training group). Street-crossing behaviours assessed in an actual traffic environment in three phases:

before training, one week after training, and six months after training. The behaviours of students in the experimental groups were significantly improved within one week, and the six-month time frames. Their performance was linearly improved by time. No behavioural difference was found among the students in the control group. After six months, there was a better improvement in the street-crossing behaviours of children in the parental learning groups, compared to the active learning group. Parental involvement is recommended as a useful strategy while designing active learning-based educational programmes aiming at the improvement of street-crossing behaviours among school-aged children. Similarly, as cited earlier, Thomson et al, (2005) constructed a training program that addressed the conceptual and strategic issues involved in learning to cross through traffic gaps with mothers as the trainers. This was a strong indication of children's ability to learn from experience and the importance of enlisting parents as role models.

Increasingly, fully immersive virtual reality is becoming the foremost method to instruct. Past research demonstrates the face validity, construct validity, and convergent validity of using virtual pedestrian environments for studying child pedestrian behaviours (Deb et al., 2017: Schwebel et al., 2008). For example, Jiang et al. (2021) designed a children's street crossing intervention method based on the behaviour spectrum and carried out road safety training focused on the improvement of children's street crossing skills. Whether from school, family, or society, these road safety interventions focusing on different components have yielded improvements in road crossing behaviour.

Meir et al. (2015) used pictures and videos of traffic scenes based on different perspectives to design a hazard perception enhancement method for children that significantly improved the observation of traffic hazard factors and the choice of crossing times when children acted as pedestrians. Trainees underwent a 40-min intervention of observing typical residential traffic scenarios in a simulated dome projection environment while engaging in a hazard detection task. Compared to children who did not receive the intervention, children in the intervention group were more dependent on the absence of a visual field when making street crossing decisions, and they made more cautious choices, especially in conditions of a restricted visual field. However, there was no long-term evaluation of the retained learning.

Schwebel et al. (2016) conducted safe walking training for children in virtual walking environments to schools or community centres, and their results showed that children's unsafe walking behaviours were moderately improved after safe walking training. Zeuwts et al. (2018) found that after a short period of observational training, child cyclists were able to identify a greater number of potential traffic hazards in less time, and their recognition rates of potential hazards and reaction times were significantly higher and even exceeded the levels of adult cyclists. There is a diversity of training formats for these intervention methods.

Lehtonen et al. (2017) designed a computer game for hazard perception enhancement based on videos from the cyclist's perspective. In the game, children were asked to watch the videos and click on a variety of traffic hazard targets to earn points. The results showed that children who completed the game training had significantly higher situational awareness scores than those who did not participate in the game, and they had significantly lower response times to targets, meaning they had more time to react when faced with traffic hazards.

Perego et al. (2018) encouraged children to reflect on various concepts in the field of road safety, and children's ability to assess road hazards improved substantially after they reflected on their experiences as traffic participants and on the hazards present in the traffic environment. Compared to the pre-training period, trained children were able to detect more hazards in static images of traffic scenes, and this improvement was confirmed across children of different genders and regions.

However, none of these have reported any long term follow up to assess longer term impacts. While these training programmes demonstrate that it is possible to improve perceptual ability, they do not contain a wider education on road safety and have not been demonstrated to maintain improved perceptual ability over time. On the other hand, results have confirmed that parents' participation plays a positive role in improving children's street behaviour (Thomson et al., 1998; Zare et al., 2019) over a longer term through positive role modelling and has the potential to be a very affordable effective manner of teaching road safety.

Section 1.3.10 Summary and Research Questions

The causes of road collisions are complex and involve several factors, including road user behaviours (pedestrian, cyclists, drivers' behaviour), traffic (volume, speed), road infrastructure (safety measures, conditions of the road), and other environmental issues (weather). The focus in this study was on the population aged between 11 and 12 years of age for whom road safety presents many challenges. While road safety education is offered to all primary schools in Ireland, not all avail of the materials and/ or the services provided by the Road Safety Authority. Therefore, there is a lack of consistent road safety messages provided to primary school children across the Republic of Ireland, with a substantial proportion of children not being provided with any RSA education programmes. While this has resulted in a gap in children's formal road safety education, they may receive this education through their parents as a part of their daily lives.

The literature presented has indicated that children aged 11 to 12 years are becoming increasingly independent road users, however, they still do not have the adult level of skills required to safely navigate complex traffic conditions such as crossing the road and contending with daily distractors when out around the roads. Research has indicated more immature attentional capacity compared to adults, which is a key requirement in identifying a safe place to cross a road and making the decision on when to cross. Children in this age group are increasingly likely to have mobile phones which is placing an additional burden of distraction on their safe road use due to their deficits in attentional capacity. Further, their perceptual ability to accurately identify gaps in the traffic and unmaterialised hazards has been demonstrated as less developed than adults, lending to higher risk road crossing. The presence of friends is an integral component of this age groups daily activities through walking to school and socialising. The literature has indicated the presence of friends and peers may also have a negative impact on their road use behaviour therefore, providing an additional level of distraction and complexity to safe road crossing. Consistent with the literature on adult road use behaviour, young males have been identified as behaving in a 'riskier' manner while socialising around and crossing roads. They are more likely to cross when the lights are red, run across roads, engage in more dangerous play and less planned protective behaviour. Research has suggested that may be down to differences in brain maturity compared to girls of the same age, how they have been socialised around risk taking differently and less compliance to rules.

Several psychological theories including the Theory of Planned Behaviour (TPB; Ajzen, 1991) and Social-Cognitive Theory (SCT; 1986) such as Bandura's Social Learning theory (Bandura,1986) have attempted to explain behavioural intent and the strongest influences on behaviour. Specific to this age group and behaviour, the identification of the most relevant 'norm' to influence behaviour is challenging, due to the competing presence of two key groups, peers and parents. By the time children are aged between 11 and 12 they are spending an increasing amount of time socialising independently from their parents, however, they are still likely to be spending a significant amount of time in the presence of their parents when performing daily routines. This provides two sets of influences which may be in competition with each other and provide competing road safety messages. Throughout a child's development adults serve as pedestrian role models and provide learning opportunities for children when walking either to school or for leisure. Adult supervision is considered within the research as a key behavioural technique for reducing child pedestrian involvement in collisions. While supervision may be deemed only applicable to younger children than the age group within this study, adult supervision can take different forms as children progress through the latter stages of primary school. The literature has indicated the efficacy of direct guidance and discussion by parents to older children providing practical demonstrations and discussions on road use behaviour. This can assist in their decision-making process and help them to identify and understand the complexities involved in road crossing within their age group compared to adults. The availability of this guidance on a day-to-day basis can be considered an important part in road safety education, away from the formal school-based programmes. To facilitate parents in their role as educators, it is important to understand their perception of risk around children's pedestrian road use. However, the literature on parental perceptions of risk for child pedestrians is limited and indicated a need to gain a better understanding of how parents perceive risk and assess their children's ability as pedestrians.

Taking into consideration the literature on the complex issues surrounding the age and perceptual related abilities of children in this age group, the impact of distraction through technology and the presence of peers, the role of modelling road use behaviours by parents, this study sought to assess the following questions:

- how do children aged between 11 and 12 years of age behave on the road?
- how do these children perceive their road safety responsibilities and beliefs?
- Are there gender differences in their reported behaviour?
- Does where they live and their level of exposure to the traffic have an impact on their behaviour?
- What is their perception of risk when playing on and crossing the roads?
- Identify potential influences on their perception of risk.
- Assess parents' perception of their child's road use behaviour.
- Assess parents' perception of risk.
- Assess the relationship between how the parents perceive their children as road users and how the children report their own behaviour and beliefs.

Chapter 2 Methodology

This research conducted two studies with data collected at two different time points and by two different methods (in person and online). For ease of reading, Section 2.1 will outline the methodology for Study 1 and Section 2.2 will provide the methodology for Study 2.

Section 2.1 Study 1: The Self-Reported Road Use Behaviour and Beliefs in an Irish Primary School Population aged 11 to 12 years.

Section 2.1.1 Ethics

Prior to commencing the study ethical consent was sought from the School of Psychology, Trinity College Dublin for the rationale of the study and the required administration of questionnaires to children aged 11 to 12 years in primary school in Ireland. As this study involved participants under the age of 16-years-old, parental consent was required for all participants in advance of testing along with the consent of the child themselves. A further consideration was the potential impact of emotional distress to children who may have had an experience of a road traffic collision themselves or within their family or friend group. Parents were asked to consider the potential impact of distress as a result of this study. Ethical approval was obtained and a copy of the letter of approval can be found in Appendix A

Section 2.1.2 Design

This study employed a quasi-experimental cross-sectional design where children in 42 primary schools across Ireland completed a two-part questionnaire simultaneously in their classroom. The independent variables included:

- education (Road Safety Authority [RSA] intervention in school, no RSA intervention in school)
- school location (rural, small urban, large urban)
- gender (male and female)
- age (11 to 12)
- road safety responsibility beliefs

- exposure to traffic on a weekly basis as a pedestrian or cyclist
- frequency of accompaniment on a weekly basis when on the roads (on own, with other children, with adults)
- experience of a near-miss in traffic (clearly explained prior to survey completion)

The dependent variable was their response on the Adolescent Road Users Questionnaire (ARBQ; Elliott & Baughan, 2004). Full details on this questionnaire are set out in Section 2.2.3 Materials. See Appendix A for the full set of questions in the ARBQ.

This study confirmed the factor structure of the ARBQ in the 11 to 12 year old population and provided a shortened 20 item version for use in the Irish primary school population. Chapter 3 outlines this process in full. The subsequent analysis for Study 1 addressing the key research questions is based on the shortened 20 item scale to facilitate comparison across previous ARBQ based studies.

Section 2.1.3 Participants and Recruitment

Forty-two schools with 1,100 children were recruited across Ireland. The age of the children in this study were 11 to 12 years. Any children who were aged 13 were excluded from the analysis. A breakdown of the population is set out in Table 2.1.

Table 2.1

Participant Demographic, N = 1100 Sample

Participant	N	%	Mean (SD)
Gender			
Male	583	53.0	
Female	517	47.0	
Age			
11-12	1,100	100	11.9 (.34)
Male			11.9 (.29)

Female			11.8 (.38)
Location of Home			
Town or village	626	56.9	
Countryside	474	43.1	
Location of School			
Rural	464	42.2	
Large Urban	286	26.0	
Small Urban	350	31.8	
RSA Road Safety Education			
Yes	483	43.9	
No	617	56.1	

A stratified sampling strategy (Shaughnessy et al., 2009) was employed in Study 1 to reflect the research questions and funder requirements. A key requirement of this project was to assess the difference in road use behaviours in children who did and did not receive an RSA education programme in school. Further, it was required to ensure a representative all Ireland geographical location, an even representation from rural and urban schools and a population matched for age and gender as closely as possible.

Education: The first step required the identification of schools which had participated in at least two RSA school road safety education programmes. The RSA hold a database of all schools which have participated in their education programmes and access was provided. The first programme 'StreetSmart' was necessary for participation as this programme addressed road use behaviour of the child themselves as a pedestrian or cyclist, rather than being a passenger. 'StreetSmart' is an interactive programme using a pretend streetscape mat and props, where children are invited to carry out everyday road safety tasks. With 'StreetSmart', children learn from their own experiences and those of their classmates through a series of activities such as: role playing and dress-up, storytelling, road safety games and an interactive road safety Q&A game. This programme is designed for three distinct age groups: 4-5, 5-8 and 8-12 years, with a combination of interactive activities suitable for each age group. The programme travels to the school and is delivered by a contracted RSA education team. Further information on 'StreetSmart' can be found on: https://www.rsa.ie/road-safety/education/road-safety-road-shows. Once primary schools who had hosted 'StreetSmart' within the previous two years was identified, the list of potential schools was further refined based on their participation in at least one other RSA school-based programme. These included the 'Safe Cross Code', 'Seatbelt Sheriff', and 'Hi-Glo Silver'. These short desktop programmes are delivered in school by the primary school teachers and can further involve entry into a poster competition for seatbelt or high visibility garment use and a class recorded 'safe cross code' dance competition. Awards for these competitions are delivered by the RSA annually. Further information on each of these programmes can be found at: https://www.rsa.ie/road-safety/education/primary.

Nationally Representative Sample: The Republic of Ireland (ROI) is divided into 26 counties and four regions (Ulster, Connaught, Leinster and Munster). Therefore, to ensure a representation from each of these regions which may have different road safety cultures, an even distribution of schools was identified from each region. Further, these schools were classified as large urban, small urban and rural, based on the location of the school.

An invitation to was sent by e-mail, to the school principal in the schools with the RSA education programmes, inviting them to participate in this research. This letter explained the study aims, outlined the research procedure and was accompanied by a School Consent Form, Parent Information form and Parent Consent form that they could return if they agreed to participate (Appendix A). Once the schools providing the required RSA programmes confirmed interest in participation, the process to enlist schools which did not provide any of the RSA school-based education programmes commenced. These schools were identified through the national database of primary schools provided by the Department of Education. These schools were matched by geographical location, large urban, small urban and rural location and finally age and gender matched. The size of participating schools with and without RSA education programmes was also matched as closely as possible to ensure a more equal balance between the two groups. As with the first phase of recruitment, an invitation to was sent by e-mail, to the school principal in the schools without the RSA education programmes, inviting them to participate in this research. This letter explained the study aims, outlined the research procedure and was accompanied by a School Consent Form, Parent Information form and Parent Consent form that they could return if they agreed to participate (Appendix A).

Once all the schools with and without RSA education were enlisted, they were contacted by telephone to arrange the time and date for data collection. This process took considerable time and had to be reviewed on an ongoing basis due to consent forms not being returned on time for data collection, unanticipated school closures and staff illness. A final set of 42 schools were confirmed and data collected. Due to the confidentiality requirement of the participating schools, the school names cannot be provided of the final sample.

Section 2.1.4 Materials

This study used a combination of instruments including the Adolescent Road-User Behaviour Questionnaire (ARBQ: Elliott & Baughan, 2004), a road safety behaviour beliefs questionnaire (Elliott & Baughan, 2004) and a set of demographic questions designed to collect data around the participants exposure to traffic and participant characteristics. These were all combined into a single questionnaire split into four sections with an approximate time for completion of 20 minutes. Please see Appendix A for the full questionnaire.

Section 2.1.4.1 Behaviour Items

The primary questionnaire utilised in this study was the Adolescent Road-User Behaviour Questionnaire (ARBQ: Elliott & Baughan, 2004) This is a self-report questionnaire designed to measures the on-road behaviour of adolescents aged 11 to 16 years as pedestrians. It also includes questions on a small number of behaviours, such as cycling, skateboarding and rollerblading on the road (Elliott, 2004; Elliott & Baughan, 2004). The factor structure of the ARBQ was based on an exploration of 2433 English students aged between 11 and 16 years old using a 43-item questionnaire. The original study produced three reliable factors: “unsafe crossing behaviour”, “dangerous playing in the road” and “planned protective behaviour”. The full range of reliability across the previous studies utilising the ARBQ are: The ARBQ also has a shortened 21-item version with good internal reliability with psychometric properties of the ARBQ investigated in New Zealand (Sullman & Mann, 2009), Spain (Sullman et al., 2011) Belgium (Sullman et al., 2012) and Iran (Nabipour et al., 2015).

Respondents are asked to rate how often they carry out certain behaviours while they are crossing or playing on or around a road. All items were rated on a 5-point Likert scale ranging from 'Never' to 'Very Often'. An example of the questions which fall under each factor include:

- How Often do you forget to look properly because you are talking to friends who are with you? (Unsafe Crossing).
- How often do you wear reflective clothing when out on foot in dark? (Planned Protective Behaviour).
- How often do you not notice an approaching car when playing games in the road? (Dangerous Play).

Please see Appendix A for the full set of ARBQ questions.

For the purpose of this study, the original 43 items were reduced to 41 items in the current research, to reflect the age of the participants and the appropriateness of the questions. A decision was made to exclude the item "cross less than an hour after drinking alcohol" as this would not be relevant to children aged 11 to 12 years. Two previous studies using the ARBQ in Iran (Nabipour et al., 2015) and China (Wang et al., 2019) also excluded this question for cultural reasons. The second question excluded was based on the age of the children and the potential for suggestibility to engage in this behaviour was "Play 'chicken' by lying down in the road and waiting for cars to come along". It was deemed ethically appropriate to remove this question for this population as it may induce curiosity and copy-cat behaviours.

Separate to the ARBQ, respondents were asked about their own involvement in a road traffic incident or collision. On a 5-point Likert scale ranging from 'Never to Fairly Often' they were asked if they had ever experienced a 'near-miss' on the road as a pedestrian. They were also asked to record if they had ever been seriously injured in a road traffic collision. While not related to their own behaviour, respondents were asked to report if someone in their immediate family or friend group had ever been killed or seriously injured in a road traffic collision. In the consent form, parents and guardians were advised if this was the case, they may not want their children to complete the questionnaire. Therefore, any child who did complete this questionnaire were aware that this was a potential question and had the full consent of their parent or guardian.

Section 2.1.4.2 Exposure items

In total, seven items were included on the questionnaire to assess the respondents' level of exposure to traffic. For consistency, six of these questions were taken from the original Elliott and Baughan (2004) study and amended to suit the current population. The questions on general exposure were: 'How often do you go out and ride a bike?'; 'How often do you go out on foot?' and 'how often do you go out and ride a scooter, skateboard or roller blades/skates?'. The addition of scooter was deemed appropriate due to the increased use of these both recreationally and as a mode of transport. A further three questions on the type of accompaniment were also included. Respondents were asked 'when you go out around the roads, how often do you do this with (1) adults, (2) friends and (3) on your own. All questions were rated on a 5-point Likert scale ranging from 'Never' to 'everyday'.

Finally, respondents were asked to identify how they travelled to school most often. Options available were: Walk; Car; Bus; Cycle; Scooter and Other.

Section 2.1.4.3 Belief and Attitude Items

Based on the Elliott and Baughan (2004) study, respondents were asked to rate how much they agreed with a series of 7 statements on their road safety beliefs on a 5-point Likert scale ranging from 'Strongly Agree' to 'Strongly Disagree'. These items were designed to measure a respondents' beliefs about how risky or safe they perceived their behaviour to be and also assessed their belief about who should be responsible for their safety while on the road. The original questions on beliefs were subjected to a principal axis factor analysis with varimax rotation. The data were best fitted by a two-factor solution accounting for 46.8% of the variance (Elliott & Baughan, 2004). Factor 1 accounted for 29.7% of the variance and included items concerned with taking responsibility for their own safety and acting responsibly. The five items on this factor were summed to produce a composite scale titled 'Responsibility Beliefs' with a Cronbach Alpha of 0.76. Factor 2 accounted for 17.1% of the variance. The two items on this factor deflected responsibility for their own behaviour. The composite scale had Cronbach Alpha of .74. This scale has been factor analysed in this study to assure its reliability prior to use, see Chapter 4.

Section 2.1.4.4 Demographic Information

Based on previous studies, respondents were asked to provide information on their age (restricted to the 11- or 12-year age group), gender, area of residence (countryside or urban centre) and location of the school (rural, small urban and large urban). It was decided to exclude the question of ethnicity reported in some of the previous studies using the ARBQ due to the profile of rural schools in Ireland.

Section 2.1.5 Procedure

All tests were administered during school hours in school classrooms or assembly halls by the principal researcher. The classroom teacher remained in the room at all times. In two schools, a special needs assistant helped the student to complete the survey. At the beginning of each data collection session the students were reminded they were under no obligation to participate in the study, and they could stop completing the study at any stage if they so wished. Further, a participant information/consent form was provided at the start of the questionnaire, and this was completed by each participant before they completed the questionnaire (Appendix A). None of the students in the classes refused to participate in the research at any time. Debriefing information was provided at the end of each administration.

The researcher distributed the questionnaire randomly among the participants and asked them not to start until they had been told to so. Before they began, a set of standardised instructions were read out and terms explained so that children were fully aware of what each question was asking. For example, a clear explanation and demonstration was provided for questions referring to ‘walking facing the traffic’, or ‘walking in single file’. Refer to Appendix A for a full set of the instructions provided including explanations of the terminology ‘near miss’, ‘hardly ever’, ‘sometimes’ etc. The researcher remained in the classroom and was available to take any questions that required clarification. These were addressed to the full class, however, few children asked for any further assistance once they had started the questionnaire.

The questionnaire took *approximately* 20 minutes to complete. However, they were reminded that there was no time to complete and to not rush their answers and to read each item clearly. Approximately ten minutes before the anticipated end of the questionnaire, the researcher asked the participants to ensure that they had not inadvertently skipped a question, which helped to minimise the incidence of missing or incomplete data. The teacher in each classroom also appealed to the children to take care and consideration when completing the questionnaire and no children left any questions unanswered. This may be a reflection of the age of children involved and their willingness to cooperate and be compliant with rules.

Data preparation and analysis: All data from the surveys were entered initially into SPSS Versions 26 to 28 where they were screened for errors. Any observed transcription errors (out-of-range values) were corrected by referring to the original scripts. The data were checked for violations of the assumptions of normality that underlie the various statistical tests that were utilised, the results of which are reported where appropriate throughout this thesis. SPSS Amos 27 was used for the confirmatory factor analysis.

Section 2.2 Study 2: Parent and Child Road Use Behaviour and Perception of Pedestrian Risk

Section 2.2.1 Ethics

Prior to commencing the study ethical consent was sought from the School of Psychology, Trinity College Dublin for the rationale of the study and the required administration of an online questionnaire to children aged 11 to 12 years in primary school in Ireland and their parent/guardian. As this study involved participants under the age of 16-years-old, parental consent was required for all participants in advance of testing along with the consent of the child themselves. A further consideration was the potential impact of emotional distress to children who may have had an experience of a road traffic collision themselves or within their family or friend group. Parents were asked to consider the potential impact of distress as a result of this study. Ethical approval was obtained and a copy of the letter of approval can be found in Appendix A

Section 2.2.2 Design

This study employed a quasi-experimental cross-sectional design hosted online via Qualtrics to matched pairs of parent and child. The independent variable (IVs) were:

- gender for parent and child (male and female)
- age
- location of residence
- number of children in the home
- birth order of the child in the survey
- main transport to school
- exposure to traffic
- frequency of accompaniment (on own, with other children, with adults)
- rating of traffic volume around the home by parent and child
- rating of the safety of traffic around their home by parent and child
- priority rating parents assigned to five potential sources of danger their child might be exposed to (serious falls, molestation, abduction, road traffic collision and severe diseases)
- parents perceived ability to reduce risks while walking on country roads or urban areas
- parents' rating of their child's capability to cross the road independently
- the child's reported road safety responsibility beliefs
- experience of an RTC either themselves or a close friend/family member in the previous 5 years (parent and child)
- self-reported unsafe crossing parent and child,
- near miss event (child only clearly explained in the survey).

The dependent variable: The measurement of risk in this study is the same as one used by Cloutier et al. (2011) and which was based on work by Lam (2001; 2005). Further details on this measure are set out in Section 2.2 .4 Materials

Section 2.2.3 Participants and Recruitment

A total of 125 matched parents and children completed the online questionnaire. The age and demographics are set out in Table2. 2.

Table 2.2

Frequency and Descriptives, N = 125

Participant	N	%	Mean
Parents			
Gender			
Male	35	28.0	
Female	90	72.0	
Age			
Male			43.4
Female			41.0
Location of Home			
Country	17	13.6	
Village	7	5.6	
Small town	14	11.2	
Large town	26	20.8	
City	61	48.8	
Child			
Gender			
Male	53	42.4	
Female	72	57.6	
Age			
11	52	42.4	
12	73	57.6	

This study was hosted online via Qualtrics. The sampling strategy was opportunity based. The RSA published a link to the survey, complete with a media campaign (radio) to help enlist a nationally representative sample. When this did not result in the anticipated number of participants, a further recruitment drive on parent social media groups was run to increase the sample and balance numbers with respect to a number of key strata including, gender, age, number of children, location and education. No IPP addresses were captured, and participants were assured of full anonymity as per the ethical consent.

Section 2.2.4 Materials

The online questionnaire comprised of items categorised under five blocks based on an extended model of risk perception first put forward by Cloutier et al. (2011). These include questions on demographic, environmental, mobility, cognitive and behavioural variables. Each of these will be outlined in more detail in the subsequent sections and the full questionnaire can be viewed in Appendix A.

Section 2.2.4.1 Demographic Variables

The data collected in this section will be used to determine the background information of the respondents and to assess the influence of these individual variables on risk perception. Variables relate to both the parent (age, gender, level of education, number of children) and child (age, gender, birth order).

Section 2.2.4.2 Environmental and Mobility Variables

Participants (both parent and child) were asked to rate the traffic volume in their residential setting on a four-point Likert scale from 'Very Light' to 'Very Heavy'. The main transport to school each day was recorded as either: walking, cycling, bus or car. The frequency of the parents walking for work or pleasure and the frequency of the child walking around either a) country roads, or b) urban areas in the accompaniment of adults, friends or on their own on a weekly basis was collected. These follow the same format as the exposure items in Study 1.

Section 2.2.4.3 Cognitive Variables

Participants (both parent and child) were asked to rate the perceived safety rating for the traffic around their home on a four point Likert scale from 'Pretty Safe' to 'Very Safe'. Parents ranked from 1 to 5 potential sources of danger to their child might be exposed to (serious falls, molestation, abduction, road traffic collision and severe diseases). Parents also rated their agreement on two statements based on their perceived ability to control risks while walking on country roads or urban areas on a five-point Likert scale from 'Strongly Agree' to 'Strongly Disagree'. The parents' were asked to rate their child's capability to cross the road independently on a four point Likert scale from 'Very

Capable' to 'Not Capable'. The child's reported road safety responsibility beliefs and corresponding parent rating of how their child would rate their road safety beliefs was recorded through the road safety responsibility beliefs questionnaire (Elliott & Baughan, 2004) as per Section 4.1.4.3. Finally, their experience of a road traffic collision (RTC) either themselves or a close friend/family member in the previous 5 years (parent and child) was recorded.

Section 2.2.4.4 Behaviour Variables

These behaviour variables are an extension of the perception of risk model (Cloutier et al., 2011). These questions were based on the 41 item ARBQ (Elliott & Baughan) and included 10 items from the 'Unsafe Crossing' factor and five from the 'Planned Protective Behaviour' factor. Children were also asked to identify how frequently they have experienced a 'Near Miss' episode on the road.

Section 2.2.4.5 Risk Perception

The measurement of risk in this study is the same as used by Cloutier et al. (2011) which was based on work by Lam (2001; 2005). It involves 8 scenarios portraying risk situations for children on or close to a street. Unlike the original study which provided pictures to accompany the questions, this study was run online via Qualtrics and so participants were asked questions only without visual aids and asked to rate the level of danger from 'Always Dangerous' to 'Never Dangerous':

How dangerous do you rate these behaviours a child might engage in (Likert scales 1 - 5)
1. Playing on a footpath
2. Playing on a country road
3. Crossing at a pedestrian crossing without traffic lights
4. Crossing when the pedestrian light is red and there are no cars coming
5. Crossing when the pedestrian light is green
6. Crossing the street other than at a pedestrian crossing (with and without signal)
7. Crossing the street without looking
8. Crossing the street from between parked cars

Although the parents did not have the additional benefit of the pictures, the reliability of the scale in Cloutier et al., (2011), alpha = 0.75 was similar to that in this sample (Alpha = 0.71). The full questionnaire can be found in Appendix A.

Section 2.2.5 Procedure

This study was designed to run on Qualtrics and was estimated to take 10 minutes for each participant (parent and child) to complete. A letter of invitation and study information was included in any social media shots (Appendix A). A consent form was included on the start of the of the Qualtrics survey which only allowed participation once consent was provided. The responses in the full survey were forced so it was not possible to move onto the next question without having completed the question prior to it. The parent was asked to complete their questions first followed by their child. Parents were asked to allow the children to complete this on their own unassisted and in confidentially to ensure methodological rigour. This survey took approximately four months to reach the sample in the present research. A total of 147 parents started the survey but due to non-completion by the child, 22 were excluded from the analysis to ensure that only matched parent and child dyads were included.

Section 2.3 Statistical Methods Utilised

There were a variety of statistical methods used in this research depending on the research question and the testing of assumptions. These included Chi Square Tests of Association, Pearson Correlation, Independent t tests, One Way ANOVA, Two Way ANOVA, Three Way ANOVA and Hierarchical Linear Regression. Validation of the ARBQ was conducted through Confirmatory Factor Analysis using AMOS Version 27 and Exploratory Factor Analysis with Principal Axis Factoring through SPAA Version 27. These methods are commonly applied in research and do not require any further elaboration. However, the use of the more sophisticated modelling process will be clarified.

Section 2.3.1 Hierarchical linear modelling (HLM)

Specialised data analysis techniques such as multilevel modelling (MM) or hierarchical linear modelling (HLM) have been developed to control for data that is nested (e.g., in this study, students nested within schools) and are very popular in determining the effect of specialised programs offered in classrooms nested within schools. This type of modelling is referred to by several names, such as hierarchical linear-, mixed level-, mixed effects-, random effects-, random coefficient (regressions), and (complex) covariance components- modelling (Raudenbush & Bryk, 2002). HLM is becoming an increasingly popular method of advanced statistical analysis due to advancements in statistical theory and statistical modelling programs (Woltman et al., 2012). Traditional statistical approaches which assume independence among observations cannot adequately treat data with a multilevel structure (Hox, 2002). Therefore, using conventional statistical techniques (ANOVA, t-test, and OLS regression) to analyse hierarchical data without properly taking into account the data dependence can lead to biased parameter estimates, inefficient standard error estimates, and therefore, inconsistent statistical inferences (Stapleton, 2012). To further explain, due to the nested relationship of the smaller sampling units within the large sampling units, observations tend to have similar or dependent responses because of the shared influence from the individual or environment (Wu et al., 2014). For example, the observed effect of a predictor may depend, in full or part, upon their belonging to a specified higher-level unit (e.g., students attending School A instead of School B). If the data are dependent upon this higher-level unit, then the residuals of individuals within the unit will be correlated – violating the independence of observations assumption of standard single-level regression (Raudenbush & Bryk, 2002). Multilevel models have been used effectively in a range of education research, including school effectiveness studies (Kreft, 1993; Lee & Bryk, 1989) where the use of this technique allows researchers to provide a close fit to the structure of the data while also accounting for clustering.

A two-level HLM was deemed appropriate for this analysis as it identifies the relationship between predictor and outcome variables by taking both level-1 and level-2 regression relationships into account. There is also an interest in exploring interactions between individual characteristics and group characteristics by testing joint effects of these characteristics on the outcome variable. For example, in this research, it might be important to assess the effects of student's road safety responsibility beliefs and whether the school offered education on road safety. This type of cross-level relationship between student-level and school-level factors cannot be examined easily using conventional approaches (Guo, 2005

Section 2.3.2 Modelling strategy

The process of constructing HLMs typically begins by fitting an unconditional (null) model. In two-level hierarchical models, separate level-1 models (e.g., students) are developed for each level-2 unit (e.g., classrooms). These models are also called within-unit models as they describe the effects in the context of a single group (Gill, 2003). In addition to testing the variance components for statistical significance, it is important to calculate the intraclass correlation coefficient (ICC). This allows the researcher to evaluate the level of non-independence in the outcome at Level 1. The ICC is the expected correlation between "any two randomly chosen individuals in the same group" and is computed as the proportion of variation in the level 1 outcome "explained by the grouping structure" (Heck et al., 2014, p. 8). Even a small amount (i.e., ICC > 0) of non-independence can translate into increased type 1 error probability when carrying out tests of predictors in a model (Hox, 2010; Pituch & Stevens, 2016) due to a downward bias in standard errors in the context of OLS regression (Osborne, 2017). Nevertheless, ICC values > .05 are often considered an indicator of a non-trivial amount of non-independence (Heck et al., 2014). In educational research with cross-sectional designs level-1 ICCs generally range between .05 and .20 (Snijders & Bosker, 1999).

Hox (2002) advocated a stepwise approach, where analysis begins with the level-one model and proceeds to both the level-two and level three models and then examines cross-level interactions whereas Snijders and Bosker (1999) suggested conducting a direct hypothesis test of the full model or using an inductive (data-driven) strategy or both. In this research a stepwise approach was employed following a general "build-up" strategy for model testing (Heck et al., 2014; Tabachnick & Fidell, 2013) starting with an unconditional means model and progressing through random-coefficient models, random intercept with means-as-outcomes model and finally intercepts and slopes-as-outcomes model to assess any interactions between level 1 and level 2 predictors (Bryk & Raudenbush 1992). All level 1 predictors both continuous and dichotomous were centred within cluster (CWC) to facilitate interpretation (Raudenbush & Bryk, 2002; Snijders & Bosker, 2012). When the CWC predictor is entered at Level 1 and the corresponding group mean is entered at Level 2 (reintroducing the mean), this provides simultaneous and unambiguous estimates of both the within-group and between-group effects of the predictor on the outcome. This model was therefore employed in this research to investigate separate within-group and between-group effects of the predictor (see Enders & Tofighi, 2007; Hox, 2017; Pituch & Stevens, 2016).

Model 1: The estimation of the unconditional model, to assess the variability in the data

Model 2: Introduction of the demographic variables at level 1

Model 3: Introduction of the corresponding group level demographic variable (reintroducing the mean) and introduced two new Level 2 predictors (school location and education).

Model 4: Introduction of an additional behaviour predictor (near miss) to account for the additional variance yet to be explained.

Model 5: Introduction of attitudinal predictors (responsibility belief and deflected belief) to account for the additional variance yet to be explained.

Model 6: This model will examine potential interactions (same level and cross level).

These models were trimmed in each stage in accordance with recommendations provided by Raudenbush & Bryk's (2002) so that non-significant predictors in one model were excluded from the next model. Finally, to explore cross-level interaction effects, it was necessary to create a new model based on a combination of the previous significant models at level 1 and Level 2. No further models were specified to avoid overfitting which would reduce the generalisability of the results. To distinguish between the models and examine possible improvements in model fit different indices can be used including the loglikelihood ratio test and the Akaike Information Criterion test (AIC). The log likelihood test is used to compare the goodness-of-fit of alternative nested models (where one model consists of a subset of the variables contained in a larger model). This uses the deviance (-2 log likelihood) of the two models by subtracting the smaller deviance from the larger one. The difference is expressed as a log likelihood chi-square statistic with the number of degrees of freedom equal to the number of different parameters in the two models and is accompanied by a significance test. When the difference is statistically significant, this indicates that the less restrictive model (the one with the highest number of variables) fits the data significantly better than does the simpler model. The (AIC; Akaike, 1987) is used to distinguish between non-nested models. However, as these models were nested, the log likelihood method was appropriate to use.

Section 2.3.3 Interpreting Effect Sizes

There were several types of analysis run in this study therefore, a combination of different effect sizes were employed relevant to each method used. When running the ordinary least squares (OLS) regression, the R^2 statistic represents the proportion of the variance explained by the predictors, however there is no direct equivalent of this in hierarchical linear regression. Instead, a pseudo- R^2 can be calculated, which compares the log-likelihood from the empty (unconditional) model to the log-likelihood from fuller models in order to measure the proportional reduction in residual variance between two nested models using this formula.

For the hierarchical linear modelling using the ordinary least squares (OLS) regression, the R^2 statistic represents the proportion of the variance explained by the predictors. When assessing the effect from the ANOVA, t-Test and Chi Squared techniques, the following rules of thumb were used to interpret values:

	Small	Medium	Large
Partial Eta (ANOVA)	.01	.06	.14
Cohens d (t-Test)	.2	.5	.8
Cramer's V (Chi Square)	.1	.3	.5

Section 2.3.4 Power of HML modelling

A disadvantage of HLM is that it requires large sample sizes for adequate power. This is especially true when detecting effects at Level 1. However, higher-level effects are more sensitive to increases in groups than to increases in observations per group. Kreft (1996) found that when using HLM a sample size consisting of at least 30 groups with 30 participants per group were required to have sufficient power to test fixed effects.

Hoffman, (1997) suggests a study with thirty groups with thirty observations each (n = 900) can have the same power as one hundred and fifty groups with five observations each (n = 750). Although Hox and Roberts (2010) showed that the estimation of the elements in the fixed part of multilevel models are unbiased under most conditions, there is general agreement that having more groups is more important than having more cases *per* group (Kreft, 1996; Peugh, 2010; Raudenbush, 2008; Snijders & Bosker, 1999). As this sample had 42 groups with the majority of cases having between 27 and 31 participants, it was deemed preferable to employ the use of HLM to account for clustering and improve the validity of the results over the slight possibility of its being under powered.

Chapter 3 Validation of the Adolescent Road User Questionnaire

Section 3.1 Background to Pedestrian Questionnaires

According to the WHO (2022) approximately 1.3 million people die each year because of road traffic crashes with more than half of all road traffic deaths among vulnerable road users: pedestrians, cyclists, and motorcyclists. Internationally, the main focus of road safety policy is directed at improving driving behaviour, however, a greater focus on pedestrian behaviour could help to reduce road deaths in two ways, one directly and the second indirectly. The first is through the application of age-appropriate evidence-based policies and measures specific to the mode of road use. The second is through the creation of a culture or climate of road safe behaviour early in life as a pedestrian which will potentially continue throughout future modes of transport. For example, in a study by Şimşekoğlu (2015) where respondents were asked about their behaviours both as car drivers and as pedestrian, results indicated that the tendency to take risks as a driver and as a pedestrian were highly correlated. This may indicate a risk-taking attitude that has developed at a younger age as a pedestrian could continue across the various modes of road use later in life. Therefore, developing an understanding of these early self-reported behaviours and attitudes is an essential step towards identifying areas which may be possible to mediate with age-appropriate education and greater awareness of the issues within the family and society more generally. A family climate for road safety (Taubman-Ben-Ari & Katz-Ben-Ami, 2012, 2013; 2015) has been shown to improve young drivers road safety through the power of parental role modelling and has the potential to impact pedestrian safety from a young age.

Indeed, many of the established pedestrian behaviour questionnaires and surveys are developed from self-reported driver behaviours, specifically the Driver Behaviour Questionnaire (Reason et al., 1990). This 50-item questionnaire originally classified driver behaviour into three dimensions: violations, errors and lapses. A further expansion of this introduced an affective dimension: aggressive behaviours (Lawton et al., 1997). According to Reason et al. (1990) there are important differentiations between violations (intentional) and mistakes (unintentional) as each have different psychological origins and require different types of remediation. Violations are defined as deliberate deviations from practices and involve social and motivational factors, whereas errors (slips, lapses, and mistakes) may be accounted for by the information-processing characteristics of the individual. As violations are associated with attitudes and motivations which in turn are influenced by the social context, they may only be addressed through a change in attitudes. Mistakes on the other hand, may be due to failures of cognitive skills and so should be impacted by educational campaigns and training courses.

The first pedestrian scale developed based on the DBQ was called the Scale of Pedestrian Behaviour (Moyano Díaz, 1997). This scale broke down pedestrian behaviour into the same three original dimensions used to study driver behaviour: violations, errors and lapses. Subsequently, Yildirim (2007) who selected items from the Moyano-Diaz scale found three dimensions of pedestrian behaviour: errors (e.g., almost got hit by a car as a result of not checking whether the road was clear), 'ordinary' violations (e.g., crossed the road when the pedestrian light was red) and a new dimension 'aggressive pedestrian behaviour (e.g. got angry with and gesticulated at another road user). The age of the samples used in these studies ranged from 17 to 60 years.

To better understand pedestrian behaviour across a wider age range (15 to 78 years), Granié et al. (2013) developed and validated a self-report scale to measure injury risk behaviours in pedestrians called the Pedestrian Behaviour Scale (PBS). This scale was developed using the conceptual framework of the DBQ (Reason et al., 1990) and scales of aggressive driver behaviours (Lawton et al., 1997) and positive driver behaviours (Özkan & Lajunen, 2005). The items were based on validated versions of the PBQ (Moyano Diaz, 1997; Torquato & Bianchi, 2010; Yildirim, 2007) along with other self-reported pedestrian behaviour scales (Elliott & Baughan, 2004; Granie, 2008). A systematic review of the PBS (Vandroux et al., 2022) has found it to be extensively cited in the literature, validated across several countries on its own and also used in combination with other questionnaires such as the ARBQ to create new self-reported questionnaires for pedestrian risk behaviours such as in Herrero-Fernandez (2015).

As the age group for this study was considerably lower than that used previously in PBS, the Adolescent Road-User Behaviour Questionnaire (ARBQ: Elliott & Baughan, 2004) was selected. Like the PBS, this is a self-report questionnaire designed to measures the on-road behaviour of adolescents as pedestrians and has been validated across five different countries. It also includes questions on a small number of behaviours, such as cycling, skateboarding and rollerblading on the road (Elliott, 2004; Elliott & Baughan, 2004). The factor structure of the ARBQ was based on an exploration of 2433 English students aged between 11 and 16 years old using a 43-item questionnaire. The analysis produced three reliable factors: 'Unsafe Crossing Behaviour', 'Dangerous Playing in the Road' and 'Planned Protective Behaviour'. These factors have similarities to the DBQ classification by Reason et al. (1990) and with the PBS, where lapses, defined as acts of omission putting the individual in a situation of personal endangerment but with no intent to take a risk, was clearly differentiated from intentional transgressions against legal rules or rules of caution. For example, Factor 1, 'Unsafe Road Crossing', comprised both error and transgression behaviours, with some transgression items also being found on Factor 2, 'Dangerous Playing in the Road'.

Another reason to select the ARBQ to survey the children aged 11 to 12 years was the availability of a shortened 21-item version with good internal reliability. The psychometric properties of the ARBQ have to date been investigated in New Zealand (Sullman & Mann, 2009), Spain (Sullman et al., 2011) Belgium (Sullman et al., 2012) and Iran (Nabipour et al., 2015). Previous research using confirmatory factor analysis (CFA) has shown that the three-factor model did not satisfactorily fit the data when using the 43-item version, but that an acceptable fit was obtained for the 21-item scale in Belgium, Spain and Iran. One study in New Zealand produced a 19-item version of the scale using exploratory factor analysis (Sullman & Mann, 2009).

Section 3.2 Confirmatory Factor Analysis Outline

Confirmatory factor analysis (CFA) was used to investigate whether the self-reported data from 11 to 12-year-olds in Ireland, complied with the previously established three-factor model comprising 43 items and the three-factor 21 item model proposed by Elliott and Baughan (2004) and supported by Sullman et al. (2011, 2012) and Nabipour et al. (2015). Amos 27 was used, and the fit was analysed using maximum likelihood (ML) estimation procedures. Although data were collected from 1,100 children, 115 children indicated they did not ride a bicycle. Therefore, for the preliminary confirmatory factor analysis, it was decided to remove these children from the sample. The resultant sample size of 985 was sufficiently large to give adequate power for the statistical analyses, as the recommendation is to use a sample that is ten to twenty times the number of parameters to be estimated in the confirmatory analyses (Lei & Wu, 2007). A breakdown of the sample can be found in Table 3.1.

Table 3.1

Age and Gender of Sample

	11 years		12 years		Total	
	N	%	N	%	N	%
Male	75	43.4	448	55.2	523	53.1
Female	98	56.6	364	44.8	462	46.9
Total	173	100	812	100	985	100

Section 3.3 Assessing Normality of the Data

Examination of the normality of the data indicated skew values outside the acceptable range and evidence of extreme kurtosis in five items. According to Kline (2016) kurtosis values ranging between 8 and 20 indicate "extreme" levels of kurtosis. Byrne (2016), citing DeCarlo, (1997) suggests that the value of kurtosis rather than skewness is more important when assessing normality in SEM, as tests of variance and covariance are more impacted by kurtosis. According to Yuan et al. (2005), Mardia's normalised estimate values > 5 can be treated as indicative of departure from multivariate normality. An examination of the Mardia's normalised estimate (multivariate kurtosis in AMOS, Table 1, Appendix B) indicates that the variables depart substantially from multivariate normality (critical ratio = 126.7). However, this significance test on its own is not a practical assessment of normality, particularly in SEM, as these tests are highly sensitive to sample size. Mardia's coefficient is almost always guaranteed to be significant with larger sample sizes, therefore, it is recommended that the significance tests be used in conjunction with the kurtosis values for individual variables (Stevens, 2012). Kurtosis values greater than 3 in magnitude may indicate that a variable is not normally distributed (Westfall & Henning, 2013). Table 1, Appendix B sets out the univariate kurtosis in five items with a range between 8 to 26, indicating extreme kurtosis.

As the data was not normally distributed, there are two main strategies that can theoretically be adopted, the first of which is the detection and subsequent removal of cases and/or variables that do not exhibit univariate normality and second, management of the non-normal data.

The extreme kurtosis in the five items was not unexpected due to the age of the population and the *extreme risk* associated with these behaviours set out in Table 3.2. As the primary aim of this model is to test the original 41 items, it was decided to keep these items, however, they may be removed in subsequent models to improve fit. While AMOS does not provide information on univariate outliers, the presence of multivariate outliers in the data can be assessed through the Mahalanobis d-squared value. Kline (2016) recommends a conservative p <.001 value, when testing each case for statistical significance. All but four cases in this data were significant at p < .001, however, not all cases can be outliers. Therefore, it was deemed not suitable to use significance testing to identify possible multivariate outliers in the dataset. Byrne (2016) has suggested that a multivariate outlier will tend to be one whose Mahalanobis d-squared value departs substantially from the others within the dataset. When using this criterion, only two cases would appear to depart significantly. There is a "break" in the Mahalanobis d-squared values with case 984 and 980 and the rest of the dataset, which demonstrate a more gradual decrease in Mahalanobis d-squared values from observation 980 through the remainder of the cases. To improve overall kurtosis, these two cases were deleted from the original data set (Byrne ,2016).

Table 3.2

Items in ARBQ with Extreme Kurtosis, N = 985

Q		Kurtosis
I 28	Hold onto a moving vehicle when on a skateboard, scooter or roller skates/blades.	26.17
I 26	Play "chicken" by deliberately running out in front of traffic	21.33
I 27	Hold onto a moving vehicle while on a bike.	19.50
I 31	Ride out onto the road on a scooter, skateboard or roller skates/blades without thinking to check for traffic.	8.31
I36	Deliberately run across the road without looking for a dare.	8.31

Section 3.4 Management of Non-Normal Data

Maximum likelihood estimation (ML) tends to be the default standard estimation approach in many SEM programs. However, the ML approach assumes that the variables exhibit multivariate normality, which this data set does not. Violations of this assumption can lead to incorrectly rejecting a reasonable model because of inflated chi-square test values. Byrne (2016) warns that this can lead to model re-specification efforts that result in models that do not generalise well beyond a current sample. It can also result in underestimation of standard errors (bias), which can lead to type I error when testing model parameters. Therefore, management of the data is required to minimize the impact of this violation.

A key element of Structural Equation Modelling (SEM) is the assessment of the fit of the estimated model to the data at hand. Model fit evaluation should be performed before any interpretation of parameter estimates, since any conclusion based on a poorly fitted model could be misleading (Maydeu-Olivares, 2017). When testing model fit in data with multivariate non normality, it is advised to use estimates that do not assume multivariate normality, such as asymptotically distribution free (ADF) estimation. However, according to Flora and Curran (2004), ADF has marked limitations with smaller sample sizes, with Byrne (2016) suggesting it is not generally recommended, except for samples with 1,000 to 5,000 cases. The current sample is less than 1000, therefore, this estimation method was deemed unsuitable. Another approach suggested in the literature was to use a chi-square adjustment, such as the Satorra and Bentler (1994) chi-square correction, however, AMOS does not facilitate this. The remaining option was to use a bootstrapping method such as the Bollen-Stine (1992) which corrects the bias associated with parametric extraction of non-normal data. AMOS 27 uses the Bollen-Stine approach to bootstrap p-values of the chi-square test statistic. Nevitt and Hancock (2001) found this technique to be better than the Satorra-Bentler correction for smaller sample size but suggest an original sample size of 500 or greater may be needed for stable bootstrap estimation. The current dataset satisfies that recommendation.

Both methods do not change the parameter estimates, rather, they alter the standard errors of the parameter estimates and the overall model chi-square. Therefore, it was decided to use the Bollen-Stine method to correct for any biasing impact that the multivariate non-normality may have had on the computed chi-square value as a function of using ML estimation. Bootstrapping draws repeated samples with replacement (called bootstrap samples) from the parent sample; the parameter of interest is then determined for each bootstrap sample and the empirical distribution of each parameter's bootstrap may be used for statistical inference. A large number of samples usually between 500 or 1000 are recommended. These repeated samples create a mini sampling distribution, and based on the central limit theorem, it should have desirable distributional characteristics. It was decided to run the same number as the original dataset as this is the approach frequently cited in the literature.

Section 3.5 Confirmatory Factor Analysis

Prior to analysis, the original 43 items were reduced to 41 items, to reflect the age of the participants and the appropriateness of the questions. A decision was made to exclude the item "cross less than an hour after drinking alcohol" as this would not be relevant to children aged 11 to 12 years. Two previous studies using the ARBQ in Aran (Nabipour et al., 2015) and China (Wang et al., 2019) also excluded this question for cultural reasons. The second question excluded based on the age of the children and the potential for suggestibility to engage in this behaviour was "Play 'chicken' by lying down in the road and waiting for cars to come along". It was felt ethically appropriate to remove this question for this population as it may induce curiosity and subsequent copycat behaviours.

Section 3.5.1 Selecting Appropriate Fit Indices for Non-Normal Data

'Model Fit' refers to the ability of a model to reproduce the data, with a good-fitting model being reasonably consistent with the data and so does not necessarily require re-specification. For models with about 75 to 200 cases, the chi square test is generally a reasonable measure of fit, however, for models with more cases (> 400), the chi square is almost always statistically significant. Therefore, the restrictiveness of the chi-square, such as sensitivity to sample size and assumption of multivariate normality has led researchers to consider alternative indices to assess model fit (Hooper et al., 2008). There is considerable controversy in the literature around fit indices. For example, (Barrett, 2007) do not believe that fit indices add anything to the analysis and only the chi square should be interpreted. The main concern is that fit indices allow researchers to claim that a miss-specified model is not a bad model while some (Hayduk, et al., 2007) argue that cutoffs for a fit index can be misleading and subject to misuse. Overall, the literature emphasises the value of fit indices, but caution against strict reliance on cutoffs. Hooper et al. (2008) suggest that a good model fit cannot generally be judged by one index alone, therefore the reporting of multiple indices is recommended. This raises the issue of cherry picking a fit index, a key source of controversy in the literature. The suggestion is that researchers can compute many fit indices and select the one index that suits their narrative the best. Therefore, to have full transparency, a wide range of the most established criteria must be presented to the reader. A further consideration is the selection of indices which are appropriate to the normality of the data. Therefore, this study must account for the non-normal data and larger sample size. One example of a statistic that minimises the impact of sample size on the Model Chi-Square is Wheaton et al. (1977) relative/normed chi-square ($\chi 2/df$). Therefore, the goodness of fit indices used in this study include the Non-Normed Fit Index (NNFI), the Bollen-Stein and relative/normed chi-square due to the non-normality of the data. In addition to these, several well-established criteria were also used to judge the acceptability of each model in this research (Byrne, 2016; Hooper et al. 2008; Kline, 2016):

- the comparative fit index (CFI)
- the root mean square of approximation (RMSA)
- the relative fit index (RFI)
- the incremental fit index (IFI)
- the non-normed fit index (NNFI; TLI, the Tucker–Lewis index)
- the standardised root mean square residual (SRMR)
- chi square divided by the degrees of freedom (df)
- The expected cross validation index (ECVI)

Accepted values for each are set out in the headings in Table 3.3. Further to this, Hu and Bentler (1999) suggested a two-index strategy whereby model fit can be accepted if RMSEA is below 0.06 and SRMR is below 0.09. However, this needs to be interpreted alongside additional fit indices.

Section 3.5.2 Model Fit

For established items, the factor loading for every item should be .6 or higher (Awang, 2015). As the standardised estimates loading factors under each latent variable in Model 1 are in the majority under .6 none of the factors are performing well. Only three items in the 'Planned Protective Behaviour' factor load over .7. Model 1 demonstrates a poor fit across most indices (Table 3.3). The relative/normed chi-square was outside an acceptable range (4.59) as greater than 3. Testing the null hypothesis that the model is correct, Bollen-Stine bootstrap (p = .001) indicated that the model was a better fit in 985 samples. While the SRMR and RMSEA both fell below the upper cut off for acceptability, in well well-fitting models the SRMR ideally fall below 0.05. Overall, they satisfy the Hu and Bentler (1999) suggested two-index strategy but taking a conservative approach, they do not indicate a good fitting model which does not require re-specification.

Table 3.3

Summary of Goodness of Fit Indices for the CFA Models

	χ2/df	RMSEA	RFI	IFI	TLI	CFI	SRMR	ECVI
	< 2/<3	<.07	.90	.90	>.95	>.93	<.08	< 2
Model 1 [a]	4.59	**.063**	.678	.745	.729	.744	**.068**	3.80
Model 2 [b]	3.58	**.053**	.748	.821	.805	.817	**.063**	2.98
Model 3 [c]	6.68	.076	.771	.823	.798	.823	**.066**	**1.26**
Model 4 [d]	3.29	**.048**	.887	**.932**	.919	**.932**	**.048**	**.636**

[a] 41 items with all the errors uncorrelated/ [b] 41 items with 9 error covariances added

[c] 20 items with all the errors uncorrelated/ [d] 20 items with 7 error covariances added

The lack of satisfactory goodness of fit for the 41-item model is consistent with previous studies on the 43 item ARBQ by Sullman et al. (2011) in Spain and Sullman et al. (2012) in Belgium. Re-specification of the model was determined through an examination of the modification indices produced as the Lagrange Multiplier (LM) test is not produced in AMOS. The modification indices identified several problem pairs. While the fit of a model can be improved through the correlation of error terms, there needs to be strong theoretical justification to do so (Jöreskog & Long, 1993; as cited in Hooper, et al., 2008).

Examination of the items indicate that redundant content may be an explanation, as many pairs of items were similar in content. For example, item "Forget to look properly because you are talking to friends who are with you" and "Forget to look properly because you are thinking about something else" are on face value very similar and may be difficult for 11- to 12-year-olds to discriminate between. Therefore, only 9 error correlations identified by the modification indices and between similar items within the same factor were allowed, 7 of which were also covaried in Sullman et al. (2011). Please see Table 3.4 for the 9 pairs which were allowed to covary.

Table 3.4

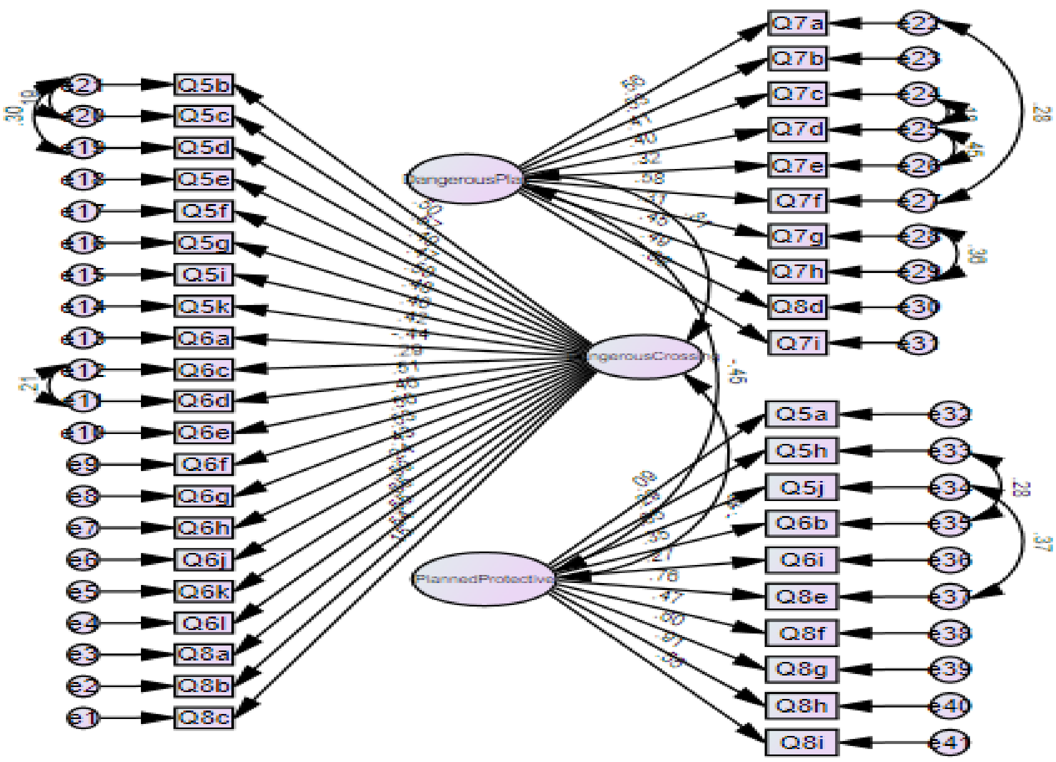
Model 2 41 Item ARBQ, 9 Pairs Co Vary

Pair	Item
1	Forget to look properly because you are thinking about something else? Use a mobile phone and forget to look properly?
2	Forget to look properly because you are thinking about something else? Forget to look properly because you are talking to friends who are with you?
3	Have to stop quickly or turn back to avoid traffic? Get half way across and then have to run the rest of the way to avoid traffic?
4	Run around on a road when playing games? Hang around on the road when talking to friends?
5	Play ''chicken'' by deliberately running out in front of traffic? Hold onto a moving vehicle when riding a bike?
6	Hold onto a moving vehicle when riding a bike? Hold onto a moving vehicle when on skateboard, scooter, or rollerblades?
7	Ride on a scooter, skateboard or roller-skates on road? Ride onto a road on a scooter, skateboard or bike without thinking to check for traffic?
8	Check to make sure traffic completely stopped before using a pedestrian crossing? Keep looking and listening for traffic Keep looking and listening until you get all the way across the road?
9	Wear reflective clothes? Wear reflective clothing when out on foot in dark?

Allowing these 9 error pairs to be correlated produced a second model (Figure 3.1 below) which did demonstrate some improvement overall, but still did not have satisfactory fit indices (see Table 3.3). Factor loadings remained similar to Model 1.

Figure 3.1

Confirmatory Factor Analysis of the 41 Item ARBQ with Standardised Factor Loadings, Model 2



Theoretically, a third model with the 41 items reduced to 36 to remove the five items with extreme kurtosis should be considered. However, as the literature has consistently been unable to provide support for the larger 42 to 43 item ARBQ, it was considered redundant. In contrast, the literature has been able to find support for the shorter item ARBQ ranging from 19 (Sulleman & Mann, 2009) to 21 items (Nabipour et al. ,2015; Sullman et al., 2011, 2012; Elliott and Baughan, 2004). The shorter version is also more likely to be utilised as a tool to examine self-reported behaviour in the primary school population aged 11 to 12 years. Therefore, the next step involved determining the suitability of a 21 items model in the Irish population. Consistent with the approach previously adopted of removing items deemed inappropriate, one item that was part of the original 21 was also removed: “Play ‘chicken’ by lying down in the road and waiting for cars to come along” resulting in a 20-item scale to be tested. Table 3.5 sets out the 20 items under each of the three factors.

Table 3.5

20 Item ARBQ

Factor 1 Unsafe Crossing
Forget to look properly because you are talking to friends who are with you?
Forget to look properly because you are thinking about something else?
See a small gap in traffic and ‘go for it’?
Cross from between parked cars when there is a safer place to cross near by?
Use mobile phone and forget to look properly?
Think you have enough time to cross safely but a car is coming faster than you thought?
Get half way across and then have to run the rest of the way to avoid traffic?
Make traffic slow down or stop to let you cross?
Factor 2 Planned Protective Behaviour
Wear reflective clothing when riding a bike in the dark?
Wear reflective clothing when out on foot in dark?
Wear reflective clothes?
Use lights on your bike when it is dark?
Wear a cycle helmet when riding a bike?
Factor 3 Dangerous Play on the Road
Ride on a scooter, skateboard or roller-skates on road?
Ride onto a road on a scooter, skateboard or bike without thinking to check for traffic?
Run into the road to get a ball, without checking for traffic?
Hold onto a moving vehicle when riding a bike?
Hold onto a moving vehicle when on skateboard, scooter, or rollerblades?
Play ‘‘chicken’’ by deliberately running out in front of traffic?
Deliberately run across road without looking for a dare

Similar to Models 1 and 2, the standardised estimates loading factors under each latent variable in Model 3 are in the majority, under .6. Only three items in the 'Planned Protective Behaviour' factor load over .7. Model 3 demonstrates a poor fit across most indices (Table 4). The relative/normed chi-square was outside an acceptable range (6.68) and the results of the Bollen-Stine bootstrap indicated that the model was a better fit in 985 samples (p = .001). Only the ECVI and SRMR fell within the accepted range, however, in well-fitting models the SRMR ideally fall below 0.05. The indices did satisfy the Hu and Bentler (1999) suggested two-index strategy. These results are again consistent with previous literature (Nabipour et al., 2015; Sullman et al., 2011, 2012) which found it necessary to respecify the model and let a number of error pairs co-vary.

Model 4 (Figure 3.2 below) was respecified with 8 pairs of errors covaried (Table 3.6), consistent with previous studies (Nabipour et al. ,2015; Sullman et al., 2011, 2012).

Figure 3.2

Confirmatory Factor Analysis of the 20 Item ARBQ with Standardised Factor Loadings, Model 4

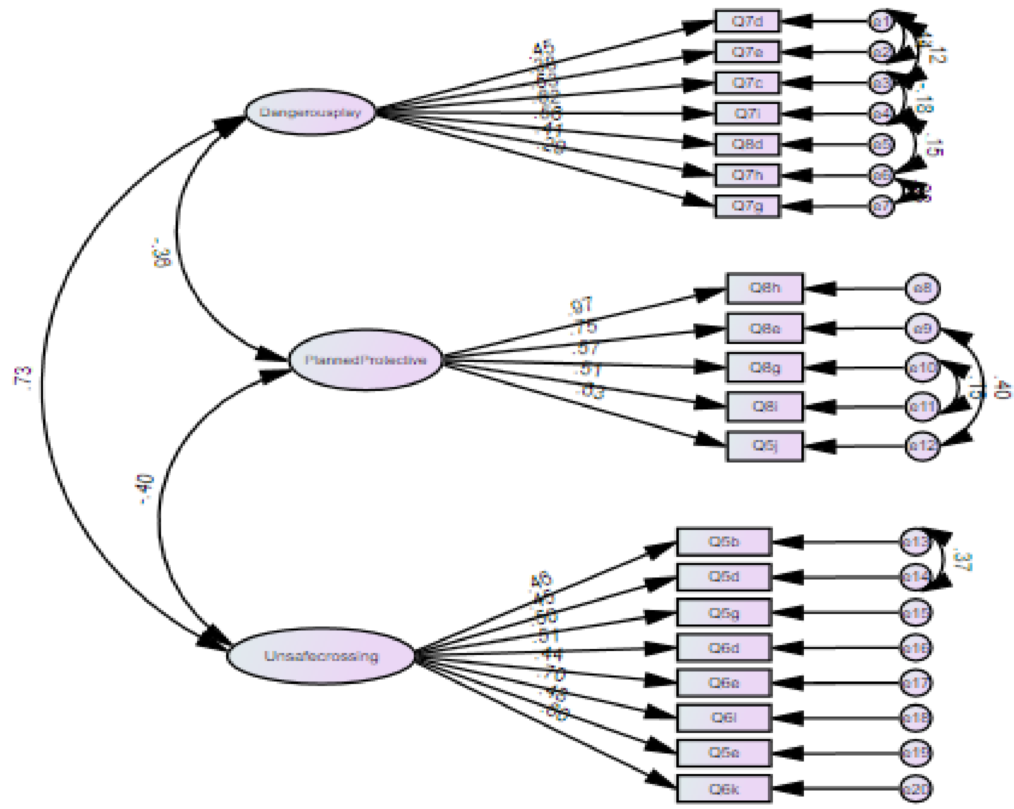


Table 3.6

Model 4 20 Item ARBQ, 8 Pairs Co Vary

Pair	Item
1	Forget to look properly because you are thinking about something else? Forget to look properly because you are talking to friends who are with you?
2	Ride onto a road on a scooter, skateboard or bike without thinking to check for traffic? Run into the road to get a ball without checking for traffic?
3	Ride on a scooter, skateboard or roller-skates on road? Ride onto a road on a scooter, skateboard or bike without thinking to check for traffic?
4	Run into the road to get a ball without checking for traffic? Play ‘‘chicken’’ by deliberately running out in front of traffic?
5	Play ‘‘chicken’’ by deliberately running out in front of traffic? Hold onto a moving vehicle when riding a bike?
6	Hold onto a moving vehicle when riding a bike? Hold onto a moving vehicle when on skateboard, scooter, or rollerblades?
7	Wear a cycle helmet when riding a bike? Use lights on your bike when its dark?
8	Wear reflective clothes? Wear reflective clothing when out on foot in dark?

While it could be deemed a satisfactory fit according to the Hu and Bentler (1999) two-index strategy and the stronger values across all indices compared to the other three models, the very restricted age range in this sample 11-12 years, compared to other studies which included ages ranging from 11 to 19 years may have resulted in lower than desired indices values. It is therefore prudent to develop a short version of the ARBQ which may be more reliable for use in just primary school children aged between 11 and 12 years due to the redundancy of some of the more high-risk activities that may be applicable to an older population. While this short version will be developed in an Irish population, it is anticipated that it will also be suitable for the more restrictive age 11- to 12-year-old group in different countries.

Section 3.6 Exploratory Factor Analysis

Section 3.6.1 The Sample

Prior to conducting the exploratory factor analysis, the original sample was split to facilitate an exploration of the factor structure on one half and a confirmation of any resultant model on the other. This was done to control for common method bias (CMB) and to limit the impact of multiple model specifications in CFA.

The literature suggests the use of cross-validation analysis to help mediate issues connected with multiple model specifications in CFA as there is the risk that modifications may be driven exclusively by characteristics of the sample being worked on (MacCallum et al., 1992). Cross-validation (Stone, 1974) involves splitting a sample into complementary subsets and conducting the analysis on one subset and validating the analysis on the other subset. The goal of cross-validation is to test a model's ability to predict new data that were not used in estimating it, to highlight problems like overfitting or selection bias (Cawley & Talbot, 2010) and to assess how the model will generalise to a different sample. Ideally, this process would extend to multiple rounds of cross-validation on different subsets with an average calculated to give an estimate of the model's predictive performance (Seni & Elder, 2010).

However, there is considerable debate in the literature on the efficacy of this approach with some authors advising against conducting EFA and CFA in the same sample by splitting it into two halves as it may lead to biased results (Hinkin et al., 1997). The literature that proposes this "incompatibility" of an EFA and CFA in one study suggest the resulting analysis may reflect the property of the data set while use of a different data set may yield a different outcome. The bias in question is referred to as common method bias. Common method bias (CMB) was first attributed to Campbell and Fiske (1959) who identified that a portion of the variance in their study may have been due to the methods used. CMB is thought to occur when the estimates of the relationships between two or more constructs are biased because they are measured with the same method (Podsakoff et al., 2003). This method bias is thought to arise for several reasons including social desirability tendencies, the tendency to respond in a lenient, moderate or extreme way, similarities in the structure or wording of survey items and the medium or location in which measurement data are collected (Podsakoff et al., 2012). According to Jordan and Troth (2020) there is general agreement in the literature that the two main detrimental effects produced from CMB are that it can bias the reliability and validity of measures and secondly, it can result in a bias of the parameter estimates of the relationships between two different constructs. Therefore, this form of bias can inflate or deflate the estimates of the relationship between two constructs and embellish or reduce the discriminant validity of a scale.

Taking this literature into consideration, to control for CMB and maintain a cross validation approach, the decision was made to split the data collected into two independent subsets while maintaining the overall integrity of the sample (large urban, small urban, rural, male, female) which may have an impact on any potential model due to specific road use experience and demographics. The data were collected across 42 schools across the Republic of Ireland over the period of a school year. Therefore, rather than a random split where there was a possibility of participants from the same school being in both data sets, 21 schools from different geographical locations were selected for each dataset to avoid any common road safety culture that may exist in a specific geographical location. One aim of the current research is to provide a scale for repeat distribution in this 11 to 12 year old primary school population to chart any changes in behaviour over time or to assess the impact of educational interventions. Therefore, in the absence of a second wave of data collection in different schools within the timeframe of this study, these two datasets align as closely as possible to future waves of data collection in the target population as no single school in a same geographical location was represented in both datasets and the same survey would be distributed to the same 11 to 12 year old primary school children. This renders the issues of CMB raised by Podsakoff et al., (2012) such as similarities in the structure or wording of survey items and the medium or location in which measurement data are collected, void. Further, there are an additional 125 children included to ensure sufficient sample size in both datasets that were removed from the first CFA due to not owning a bicycle. This provides further unique qualities to these data sets and help control for CMB. As the split was made based on an even number of schools in each dataset, it was not possible to match the gender or urban/ rural distribution exactly. However, they remain mostly similar when the large urban and small urban in each data set are combined ensuring a relatively stable urban/rural divide. Table 3.7 sets out the final numbers in each subset with 563 children aged 11 to 12 years in the EFA sample. This sample size complies with the recommendation for EFA to use a sample of at least 300 participants (Tabachnick & Fidell, 2013) and exceeds a ratio of 5:1 participants to variables (Kyriazos, 2018).

Table 3.7

Population in EFA and CFA Datasets

	EFA	CFA
Male	290	293
Female	273	244
Large Urban	124	162
Small Urban	199	151
Rural	240	244
N	563	537

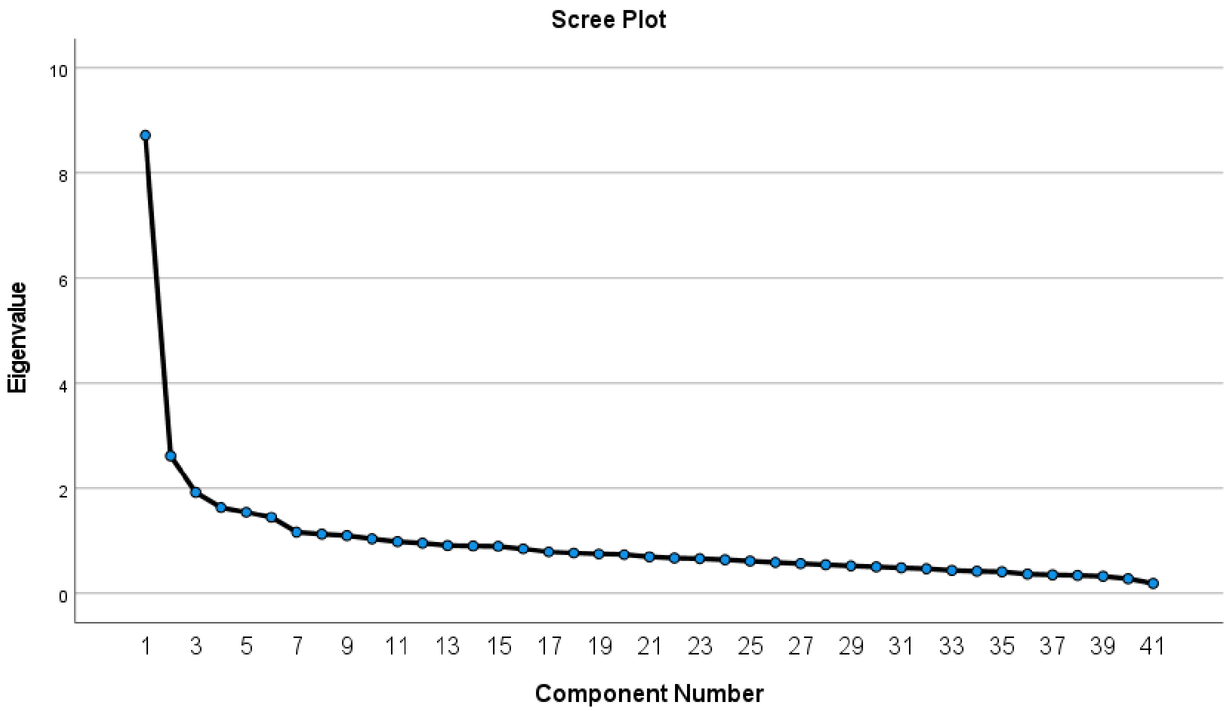
Section 3.6.2 Exploratory Factor Analysis on 41 Items

In line with the original authors and previous studies (Eliott & Baun, 2004; Sullman & Mann, 2009; Nabipour et al., 2015) to explore the factor structure of the ARBQ, the 41 behaviour items were subjected to Principal Axis Factoring (PAF) with varimax rotations. The Kaiser–Meyer–Olkin (KMO) was 0.88 and Bartlett's test of sphericity was significant (<0.001), suggesting that the data were appropriate for EFA. The ARBQ in both long and short form has consistently found three factors 'Dangerous Crossing', 'Dangerous Play' and 'Planned Protective Behaviour'.

Initial extraction resulted in 10 factors with eigenvalues > 1.0, however, the scree plot suggested three factors best described the data (Figure 3.3) as they accounted for the majority of the variance and supported the three-factor structure stated in previous literature (Eliott & Baughan, 2004; Sullman & Mann, 2009; Nabipour et al., 2015).

Figure 3.3

Scree Plot of 41 item ARBQ



The three-factor solution accounted for 32.3% of the variance similar to the 34.6% found in the UK (Eliott & Baun, 2004) and 32.1% in New Zealand (Sullman & Mann, 2009) see Table 3.8. As discussed previously, the original 43 items were reduced to 41 items in the current research, to reflect the age of the participants and the appropriateness of the questions.

Table 3.8

Principal Axis Factor Analysis of the 41 ARBQ Behaviour Items (Varimax Rotation)

Item (How often do you. . .)	Unsafe crossing	Planned Protective Behaviour	Dangerous Play
Forget to look properly because you are talking to friends who are with you?	**0.60**		
Forget to look properly because you are thinking about something else?	**0.58**		
See a small gap in traffic and 'go for it'?	**0.58**		
Run across a road without looking because you are in a hurry?	**0.58**		
Cross from between parked cars when there is a safer place to cross near by?	**0.55**		
Not notice a car pulling out from driveway and walk in front of it?	**0.55**		
Not look because you can't hear traffic around?	**0.54**		
Use mobile phone and forget to look properly?	**0.54**		
Think you have enough time to cross safely but a car is coming faster than you thought?	**0.53**		
Get half way across and then have to run the rest of the way to avoid traffic?	**0.51**		
Cross from behind a stationary vehicle?	**0.49**		
Not bother walking to a nearby crossing to cross the road?	**0.49**		
Cross without waiting for the "green man" at pedestrian lights?	**0.43**		
Cross when can't see very well both ways (bend or top hill) ?	**0.43**		
Climb over barriers or railings that separate the road from the footpath?	**0.43**		
Keep looking and listening for traffic Keep looking and listening until you get all the way across the road?	**-0.40**		
Look both ways before crossing?	**-0.40**		
Cross whether traffic is coming or not, think the traffic should stop for you?			
Have to stop quickly or turn back to avoid traffic?			
Check to make sure traffic completely stopped before using a pedestrian crossing?			
Deliberately run across the road without looking, for a dare?			
Use a lollipop man/lady where there is one available?			
Walk facing the traffic when on roads without footpaths?			
Make traffic slow down or stop to let you cross?			
Wear reflective clothing when riding a bike in the dark?		**0.82**	
Wear reflective clothing when out on foot in dark?		**0.76**	
Wear reflective clothes?		**0.69**	
Use lights on your bike when it is dark?		**0.65**	

Item (How often do you. . .)	Unsafe crossing	Planned Protective Behaviour	Dangerous Play
Wear a cycle helmet when riding a bike?		**0.61**	
Walk in single file on roads without footpath?		**0.54**	
Cross at a place that is well lit when it is dark?		**0.40**	
Run around on a road when playing games?			**0.71**
Hang around on the road when talking to friends?			**0.63**
Ride on a scooter, skateboard or roller-skates on road?			**0.62**
Not notice an approaching car when playing games in the road?			**0.55**
Ride onto a road on a scooter, skateboard or bike without thinking to check for traffic?			**0.54**
Run into the road to get a ball, without checking for traffic?			**0.48**
Walk in the road rather than on the footpath?			**0.40**
Hold onto a moving vehicle when riding a bike?			
Hold onto a moving vehicle when on skateboard, scooter, or rollerblades?			
Play ‘‘chicken’’ by deliberately running out in front of traffic?			
% Variance explained	14.1	9.63	8.47

Note: Figures in bold show item loadings greater than .4.

Factor 1 (unsafe crossing) accounted for 14.1% of the variance and consisted mostly of items which loaded on Elliott and Baughan’s (2004) ‘Unsafe Road Crossing’ factor. The behaviours ranged from distracted crossing such as ‘‘forget to look properly because you are talking to friends’’ (.60) to more risky decisions about when and where to cross ‘‘see a small gap in traffic and go for it’’ (.58) and indication of poor perceptual judgement “think it is OK to cross safely, but a car is coming faster than you thought” (.53). In total, 17 of the items loaded greater than .40 on Factor 1 and included all but two of the same items as the UK which also loaded at >.40 on Factor 1. One of the items “cross whether traffic is coming or not, think the traffic should stop for you” which loaded at .55 in the UK loaded at .39 in the Irish sample. The second item “walk on the road rather than the footpath” loaded at .43 on Factor 1 in the UK but loaded at .40 on Factor 3 in Ireland (It did load at .35 on Factor 1 here but the current criteria as per the original research is set at loadings of .40). While the majority of the items on Factor 1 relate to unsafe crossing, one planned protective behaviour item “Look both ways before crossing” loaded more strongly on Factor 1 on both the UK and Ireland (-.40 in Ireland and -.34 in the UK).

However, "Keep looking and listening until you get all the way across the road" loaded more strongly onto Factor 1 in Ireland (-.40) but more strongly (.42) on Factor 3 in the UK which relates to 'Planned Protective Behaviour'. The change in the order of extraction of the factors from the original Elliott and Baughan (2004) study is consistent with validation and exploratory factor analysis in both Iran and New Zealand on the 21 items scale. In both of these countries, the original Factor 1 'Unsafe Crossing' swapped places with 'Dangerous Play'. None of the studies to date have resulted in 'Planned Protective Behaviour' accounting for more variance than 'Dangerous Play'. This may be indicative of the restricted 11- to 12-year-old age range where dangerous play is less likely to be performed.

Factor 2 accounted for 9.6% of the variance and encompassed behaviours relating to 'Planned Protective Behaviour'. This is different from the UK, where Factor 2 reflected 'Dangerous Play on the Road' but similar to Factor 3 in Elliott and Baughan (2004). To keep consistency in interpretation of the factor loading with the UK, Factor 2 loadings in this sample will be compared with Factor 3 in the UK. The items loading most strongly on to this factor involved predominately the use of protective clothing and equipment such as reflective clothing, cycle helmets and bicycle lights. The items that loaded most strongly on to this factor included ''wearing bright or reflective clothing when riding a bike in the dark'' (.82), ''wearing bright or reflective clothing when out on foot in the dark'' (.76) to "walk in single file on roads without pavements" (.54) and " cross at a place that is well lit when it is dark " (.40). All of the items which loaded over .40 on the planned protective behaviour factor in the UK also loaded over .40 in Ireland, with the exception of "Keep looking and listening until you get all the way across the road" as noted earlier.

Factor 3 accounted for 8.5% of the variance and represented 'Dangerous Play on the Road' and was similar in nature to Factor 2 in the UK (Eliott & Baughan, 2004). Just seven items loaded over .40 compared to 11 in the UK. The Items which loaded onto this factor in Ireland may indicate a lack of awareness of personal safety and distraction such as "run around road when playing games " (.71), ''hanging around in the road talking to friends'' (.63), " ride a scooter, skateboard or roller-skates on road" (.62) or ''not noticing an approaching car when playing games in the road'' (.55). It is interesting to note that the more deliberate participation in ''dangerous'' behaviour such "hold on to a moving vehicle when on a bike" loaded at .38 compared to .65 in the UK and the two remaining high risk activities ''playing chicken by deliberately running out in front of traffic" or "hold onto a moving vehicle when on skateboard, scooter, rollerblades" failed to load on any factor greater than .30. This may be indicative of the younger and more restricted age range in this sample (11 to 12 years).

Section 3.6.3 Assessing Reliability of the 41 Item Scale

The 17 items loading onto Factor 1 were summed to produce a composite scale called 'unsafe road crossing behaviour'. Two items which loaded negatively on to this factor were reverse coded before the composite scale was produced so that high scores on every item corresponded to less desirable performance from a road safety point of view (Elliott & Baughan, 2004). This scale had high internal reliability, with the Cronbach's Alpha = 0.86.

The seven items loading onto Factor 2 were summed to produce a composite scale called "planned protective behaviour" with an internal reliability of .81. However, the reliability would increase to .83 upon removal of the item "cross at a place that is well lit when it is dark". Therefore, this item was removed resulting in a six-item scale with reliability of .83.

The seven items loading onto Factor 3 were summed to produce a composite scale called "dangerous play on the road". This scale demonstrated acceptable reliability with Cronbach's Alpha = .76.

Section 3.6.4 Creation of Shorter ARBQ

A key aim of this study was to develop a reliable self-report instrument for measuring the road use behaviour of children aged 11 to 12 attending Irish primary schools. While the 41-item ARBQ has demonstrated strong reliability for the three sub scales created from items loading at greater than .40, due to its length and the age of the population, a shortened instrument that can reliably measure the factor structure found in the 41 item ARBQ may be more suitable. Therefore, the 10 items loading most strongly on Factor 1 (> .50) and the seven items each loading on Factor 2 and Factor 3 over .40 (Table 3.8) were considered alongside an examination of the communalities, inter-item correlations and reliability analysis of composite scales. There appears to be no fixed level for what degree of communality qualifies a variable as having sufficient common variation to retain in a factor solution, however, low values (less than .3) indicate that the item does not fit well with other items in its component (Pallant, 2008). Therefore, many suggest a cut-off point as .3 while others suggest when using principal axis factoring with Promax rotation a cut off of .4 is more suitable (Osborne et al., 2008). As this study used varimax rotation, any items that loaded less than .3 in the table of communalities were considered for exclusion in the shorter scale. Comrey and Lee (2013) suggested that items loading over .71 (50% shared variance) have an excellent fit with the factor, those loading over .63 (40% shared variance) a very good fit, over .55 (30% shared variance) a good fit, and over .45 a fair fit (20% shared variance). This resonates with Costello and Osborne's (2005) recommended threshold for loadings of .50 or higher. Furthermore, both pairs of authors caution against retaining items loading below .30. So items with factor loadings above this .45 threshold would therefore make excellent scales when combined.

A Cronbach Alpha was produced for Factor 1 with 10 items, resulting in a high reliability score of .83. Removal of any items would reduce this score and none of the items included had communalities less than .3. Therefore, it was decided to keep these 10 items for further exploration. For Factor 2, the seven items that loaded over .40 were subjected to a reliability analysis. The original alpha of .81 would increase to .83 if item 20 (cross at a place that is well lit after dark) was removed. This item also had a communality of .20. Removal of another item (38; walk in single file on a road with no footpath) would further increase the reliability to .84. This item however, had a communality of .30. As it was just at .30 it was deemed appropriate to exclude based on the increase of reliability, therefore, items 20 and 38 were removed from consideration in the final shortened scale. Finally, a reliability analysis was conducted on the seven items in Factor 3 loading greater than .40. The reliability was high with a score of .76. There was, however, a problematic item in this potential sub scale. Item 31 item (ride onto a road on a scooter, skateboard or bike without thinking to check for traffic) had a communality of .29 but removal would decrease the reliability from .76 to .75. An examination of the inter item correlation matrix indicated consistently low correlations < .30. therefore, it was decided to remove item 3 from this scale as the loss of reliability was minimal and it was not contributing in a significant manner overall to the scale.

Therefore, to establish the final factor structure, the 21 items were subjected to another principal axis factor analysis with varimax rotation. A three-factor solution was specified. The total variance explained was 47.62%. The results demonstrated all the items relating to 'Unsafe Road Crossing' loaded strongly onto Factor 1, all 'Planned Protective Behaviour' items loaded strongly onto Factor 2. However, one item relating to 'Dangerous Playing in the Road' cross loaded onto Factor 1 and Factor 3 greater then .40. An inspection of the inter-item correlation matrix indicated loadings greater than .3 across all but one of the relationships. The communality of the item was .46 and reliability of this sub scale would decrease from .75 to .72 if removed. However, it was decided to remove this item as it may have an impact on the discriminant validity if kept in the scale due to the cross loading. The final factor analysis was repeated with the 20 items remaining and the factor loadings can be seen in Table 3.9. All items loaded cleanly onto each factor after rotation, greater than .45 indicating an excellent scale fit (Costello & Osborne, 2005)

Table 3. 9

Principal Axis Factor Analysis of the Final 20 ARBQ Behaviour Items (Varimax Rotation)

Item (How often do you. . .)	1	2	3
Forget to look properly talking to friends	0.71		
Forget to look properly because thinking about something else	0.66		
Run across a road without looking because in a hurry	0.65		
Use mobile phone and forget to look properly	0.62		
Not look because can't hear traffic	0.58		
Not notice a car pulling out from driveway and walk in front of it	0.57		
Think have enough time to cross but car faster than thought	0.57		
Get half way across and then have to run rest of way	0.56		
See a small gap in traffic and go for it	0.56		
Cross from between parked cars when safer place nearby	0.55		
Wear reflective clothing when riding a bike		0.88	
Wear reflective clothing when out on foot in dark		0.79	
Wear reflective clothes		0.74	
Wear a cycle helmet when riding a bike		0.69	

Use lights on bike when dark		0.69	
Run around road when playing games			0.77
Hang around on road talking to friends			0.68
Not notice an approaching car when playing on road			0.62
Ride a scooter, skateboard or roller skates on road			0.59
Walk in the road rather than on footpath			0.45
% Variance explained	20.30	15.95	11.74

The UK study (Elliott & Baughan, 2004) found the three-factor solution accounted for 43.8% of the variance in the 21-item scale. In this study, the 20-item scale accounted for was 47.99% of the variance.

Factor 1, "dangerous crossing" accounted for 20.3% of the variance and contained seven of the same items as the UK study and included an additional two. The item "cross whether traffic is coming or not, think the traffic should stop for you" was not included on the Irish scale as it did not load higher than .40 in the original factor analysis on the 41 items. The three different items on the Irish scale were "use mobile phone and forget to look properly", "not notice a car pulling out from driveway and walk in front of it" and "not look because you can't hear traffic around". The strong loading and inclusion of "use a mobile phone" may be reflective of the increase in mobile phone use in this population since the original study in 2004.

Factor 2, 'Planned Protective Behaviour accounted for 15.95% of the variance and contained five items all of which were the same as the original UK study. Factor 3, 'Dangerous Play on the Road accounted for 11.74% of the variance and contained 5 items, only one of which is the same as that found in the UK "ride on a scooter, skateboard or roller-skates on road". As noted earlier when examining the 41 item ARBQ, the difference in the lack of awareness versus deliberate risk taking may be reflective of the age of the population in the Irish sample (11 to 12 years) as the original paper included ages up to 18 years.

While the original authors did not provide a specific breakdown of the separate factor analyses of the 21-item ARBQ they run for each group (age, gender, area type) they noted that in each analysis, individual items loaded exclusively onto just one factor (i.e., did not load onto other factors greater than .4). This indicated the three- factor structure found for the entire sample was robust; irrespective of age, sex or area type (Elliott & Baughan, 2004).

To verify the factor structure found in the Irish sample, the next step is to conduct a confirmatory factor analysis on the second subset of the full dataset. For established items, the factor loading for every item should be .6 or higher (Awang, 2015). As the standardised estimates loading factors under each latent variable in Model 1 are in the majority under .6, none of the factors are performing well. Only three items in the 'Planned Protective Behaviour' factor load over .7. As the development of a shorter ARBQ for the 11- to 12-year-old Irish population involves the refinement of models it was deemed appropriate to include the Akaike Information Criterion (AIC; Akaike, 1974) in the reporting indices. The AIC, like the BIC, BCC, and CAIC, is regarded as an information theory goodness of fit measure--applicable when maximum likelihood estimation is used (Burnham & Anderson, 2003). These indices are used to compare different models with the model that generates the lowest values deemed optimal. The absolute AIC value is irrelevant as only the AIC value of one model relative to the AIC value of another model is meaningful.

Like Model 1, in Model 2 the majority of items did not load higher than .6, however, there was an improvement in factor loadings for several items across the three factors. Overall, both the SRMR and RMSEA fell below the upper cut off for acceptability, with well well-fitting models demonstrating an SRMR ideally below 0.05 (Table 3.10). Overall, they satisfy the Hu and Bentler (1999) suggested two-index strategy. Allowing items to covary can improve the fit of a model (Jöreskog & Long, 1993), therefore re-specification of the model was determined through an examination of the modification indices as the Lagrange Multiplier (LM) test is not produced in AMOS. The modification indices identified several problem pairs. Allowing these 8 items to be correlated produced a second model (Figure 3.4) which did demonstrate a satisfactory fit. An examination of the indices indicated that the IFI, CFI along with the RMSEA, SRMR and ECVI all reached the required cut-off criteria. Further to this, while the TLI did not reach the .95 cut-off to indicate an excellent fit, literature still states that values > .90 are considered indicative of a good fit (Byrne, 1994). By comparing both models there is a decrease in the AIC from Model 1 to Model 2 indicating that Model 2 is the superior fit.

Table 3.10

Summary of Goodness of Fit Indices for the 20 Item ARBQ for 11-12 year olds

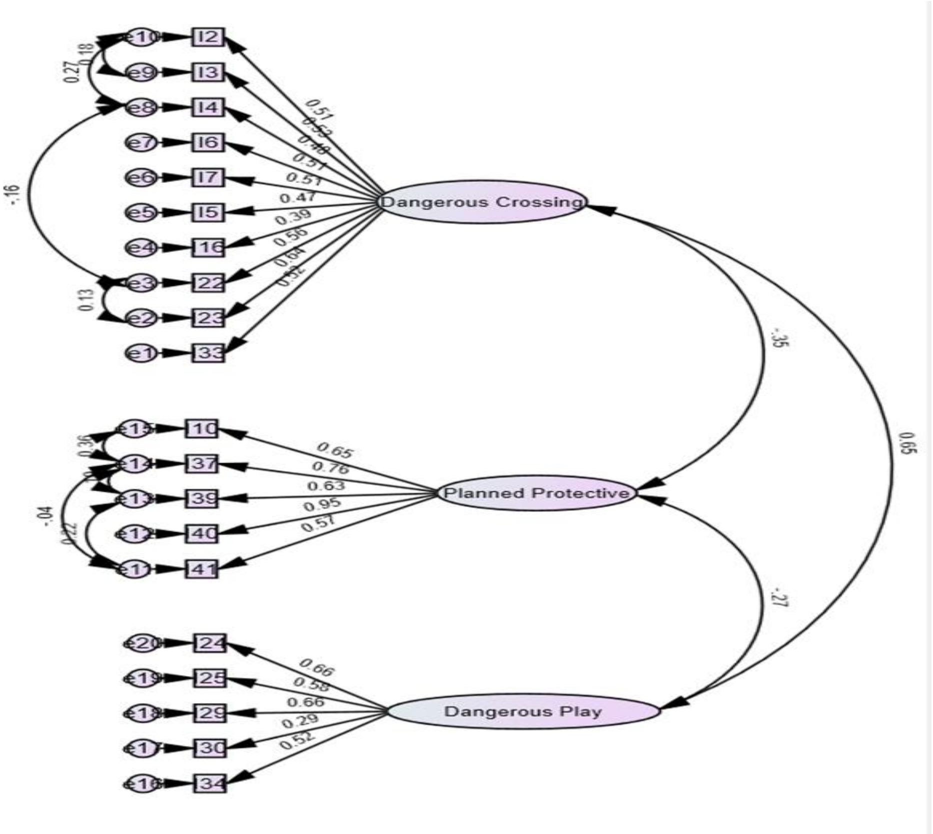
	χ2/df	RMSEA	RFI	IFI	TLI	CFI	SRMR	ECVI	AIC
	<2/ < 3	<.07	.90	.95	>.95	>.95	<.08	< 2	NA
Model 1 [a]	**2.87**	**.06**	.82	.89	.88	.89	**.05**	**1.1**	566.3
Model 2 [b]	**1.91**	**.04**	.88	**.95**	.94	**.95**	**.04**	**.76**	**405.9**

[a] 20 items with all the errors uncorrelated.

[b] 20 items with 8 error covariances added.

Figure 3.4

Confirmatory Factor Analysis of the 20 Item ARBQ for 11 to 12 year Olds



To complete the analysis, an examination of the discriminant validity was conducted. Model 2 demonstrated good discriminant validity across all three factors as the square root of the average variance extracted (AVE) was greater than the correlations between latent variables (Table 3.11). The full 20 item scale reliability as per Cronbach Alpha = .87, (F1 = .83; F2 = .84; F3 = .72) indicating a reliable scale with discriminant validity suitable for use in the 11 to 12 year old Irish population.

Table 3.11

Discriminant Validity 20 Item ARBQ for 11–12-year-Olds

	Square Root of AVE
Dangerous Crossing	0.51
Planned Protective	0.72
Dangerous Play	0.56

Overall, the present research supported the three-factor structure and was clearly measuring latent variables similar to those originally identified by Elliott and Baughan (2004). Consistent with previous studies using CFA which have shown that the three-factor model did not fit the data when using the long version (Nabipour et al. ,2015; Sullman et al., 2011, 2012) this research was unable to support the 41 item ARBQ created for the Irish population. However, consistent with previous research (Nabipour et al. ,2015; Sullman et al., 2011, 2012) acceptable goodness-of-fit indices were obtained for a shortened scale. The main difference was that rather than a 21 item as per the previous research, this study found support for a 20-item scale similar to New Zealand (Sullman & Mann, 2009) whose exploratory factor analysis could only find support for a 19 item version of the ARBQ. While the 20 item was deemed to be acceptable, not all indices were as strong as desired. Therefore, it was deemed preferable to explore the factor structure in the Irish population further, with a view to the creation of a short version suitable for the more restricted age range than previously tested (11- to 12-year-olds).

An exploratory factor analysis was conducted on the 41-item scale leading to the creation of a shorter scale. Two iterations of a short scale were produced with the final 20 item scale demonstrating strong reliability and discriminant validity (Table 3.9). The key difference in this scale from previous research is the change in the order of the factor structure with Factor 1 remaining as 'dangerous crossing' but factor 2 becoming 'planned protective' behaviour and Factor 3 'dangerous playing'. This could reasonably be explained by the age range in this study as engaging in more dangerous play on the road may become more relevant with greater autonomy on the roads later in adolescence.

In conclusion, the present study confirmed the psychometric properties of the ARBQ in Ireland and is deemed appropriate for use in the 11 to-12-year-old primary school population in Ireland.

Chapter 4 Analysis of the Reported Road Use Behaviour in Children Aged 11 to 12 In Ireland

Section 4.1 Measures and Sample

The data in this section were collected through the Adolescent Road User Behaviour Questionnaire (ARBQ) and supplementary questions designed to collect demographic data along with road safety beliefs and exposure to traffic. Each of the items are set out in Section 2.1.4 Materials.

A total of 1,100 questionnaire were fully completed across 42 primary schools in the republic of Ireland. Primary school in Ireland has 8 class groups: Junior, Senior, First, Second, Third, Fourth, Fifth and Sixth class. Children typically start between the ages of 4 and 5 but must have started school by the age of 5. This sample was recruited from Sixth class only and the age was restricted to 11- and 12-year-olds. While there may be children who are 13 by the time they complete primary school, the data collection was at the start of the school year and ran until the end of March. As the number of children aged 13 was predicted to be very low, it was decided to exclude them from the study. This also kept the 11 to 12 age band comparable to previous studies using the ARBQ who used 11-12, 13-14, 15-16 and 16+ groupings. Table 4.1 sets out the Frequency and descriptives of the current sample. Full details on the recruitment and procedure can be found in Chapter 2 Methodology.

Table 4.1

Frequency and Descriptives, N = 1,100 Sample

Participant	N	%	Mean (SD)
Gender			
Male	583	53.0	
Female	517	47.0	
Age			
11-12	1,100	100	11.9 (.34)
Male			11.9 (.29)
Female			11.8 (.38)

Location of Home		
Town or village	626	56.9
Countryside	474	43.1
Location of School		
Rural	464	42.2
Large Urban	286	26.0
Small Urban	350	31.8
RSA Road Safety Education		
Yes	483	43.9
No	617	56.1

Section 4.2 Exploration of the Data

To assess the behaviours reported by the children in the current sample, frequencies of individual Likert items were calculated and examined along with composite scores for each of the three factors. Consistent with the previous studies examining road use behaviour through the ARBQ, these composite scales were created for each factor from the shortened scale (Table 4. 2) rather than the full 41-item scale.

Table 4.2

The 20- Item ARBQ with Factor Loadings and Reliability

Item (How often do you. . .)	
Factor 1. Unsafe Crossing, Reliability = .0.83	
Forget to look properly because you are talking to friends?	0.71
Forget to look properly because you are thinking about something else?	0.66
Run across a road without looking because you are in a hurry?	0.65
Use a mobile phone and forget to look properly?	0.62
Not look because you can't hear any traffic around?	0.58
Not notice a car pulling out from a driveway or entrance and walk in-front of it?	0.57

Think you have enough time to cross safely but a car is coming faster than you thought?	0.57
Get half way across a road and then have to run the rest of the way to avoid traffic?	0.56
See a small gap in traffic and 'go for it'?	0.56
Cross from between parked cars when there is a safer place to cross nearby?	0.55
Factor 2. Planned Protective Behaviour, Reliability = 0.84	
Wear reflective clothing when riding a bike in the dark?	0.88
Wear reflective clothing when out on foot in the dark?	0.79
Wear reflective clothing?	0.74
Wear a cycle helmet when riding a bike?	0.69
Use lights on your bike when it's dark?	0.69
Factor 3. Dangerous Playing on Road, Reliability = 0.75	
Run around in the road (when playing football or other games)?	0.77
Hang around on the road talking to friends?	0.68
Not notice an approaching car when playing on road	0.62
Ride a scooter, skateboards or roller-skates on the road?	0.59
Walk in the road rather than on the footpath?	0.45

The 10 items loading onto Factor 1 'Unsafe Road Crossing' behaviour in the current sample were summed to produce a composite scale with high internal reliability (.83). Higher scores in this scale indicated less desirable road use behaviour demonstrating risky road crossing activity. The five items loading onto Factor 2 'Planned Protective Behaviour' were summed to produce a composite scale with high internal reliability of .83. Higher scores on the scale represented greater frequency of planned protective behaviour which indicates more desirable road use behaviour. The five items loading onto Factor 3 'Dangerous Play on the Road' were summed to produce a composite scale which demonstrated acceptable reliability (.76). Higher scores in this scale indicated less desirable road use behaviour as a result of greater frequency of reported risky behaviours such as playing on a road.

The mean scores for each scale presented in Table 4.3 indicate that the sample lay on the mid to lower end of each scale which may be a reflection of the age of the sample and the level of autonomy children aged 11 to 12 have on the roads. As this is Likert data that has been summed, the median has also been presented. For each scale the median aligns very closely to the mean indicating that either are suitable to report in this sample.

Table 4.3

Descriptive Statistics for the Three ARBQ Factors in the Irish Sample

	Min	Max	Mean	SD	Median	Skew	Kurt
Unsafe crossing	10	48	21.95	6.19	22	0.63	0.31
Planned protective	5	25	12.96	5.65	12	0.27	-0.99
Dangerous play	5	23	9.88	3.55	9	0.65	0.03

The issue on whether to use the mean or the median as a measure of central tendency has an implication for the inferential analysis conducted later in this study. There is a long -standing debate in the literature on which measure of central tendency to report and the appropriate statistical treatment of Likert data due to its ordinal nature (Carifio & Perla, 2008). In general, if the data are ordinal, then non-parametric statistics are typically considered the most appropriate option for analysis. If the data are interval, then parametric statistics can be used. Likert scales usually take the form of a 5- or 7-point ordinal scale used to rate the degree to which a respondent agrees or disagrees with a statement. The crux of the argument is that in an ordinal scale, where responses are rated or ranked, the distance between responses is not directly measurable. The differences between responses such as "always," "often," and "sometimes" commonly found on a Likert scale are not necessarily equal. Therefore, it is not reasonable to just assume that the difference between responses is equidistant. On the other hand, with interval data the difference between responses can be calculated as the numbers are measurable. Therefore, a mean and standard deviation is difficult to interpret in Likert scale responses as what does the average of "always" and "often" mean? Furthermore, if responses are clustered at the high and low extremes, the mean may appear to be the neutral response, which might not be an accurate representation of the data. Historically, experts have argued that the median should be used as the measure of central tendency for Likert scale data (Jamieson, 2004) and non-parametric tests used for analysis rather than parametric tests which use the mean score (e.g., *t*-tests, analysis of variance, Pearson correlations, regression). However, others (Sullivan & Artino, 2013) suggest that where there is an adequate sample size (at least 5–10 observations per group) and if the data are normally distributed (or nearly normal), parametric tests can be used with Likert scale ordinal data. Norman (2010), a leader in medical education research methodology provided evidence based on examples using real and simulated data, that parametric tests can be used with ordinal data from Likert scales as they are sufficiently robust to yield largely unbiased answers that are acceptably close to "the truth" when analysing Likert scale responses. Further to this, a second school of thought supports the treatment of ordinal data like interval data when the aim of the research is to combine items in order to generate a composite score for an individual rather than separate analysis of an individual item across all the respondents (Joshi et al., 2015). In this instance, the summative score of a respondent provides a realistic distance from the summative score of a different respondent, thereby it can be labelled as interval estimates (Boone & Boone, 2012; Carifio & Perla, 2008).

Therefore, as the composite scores in this study each represent a latent variable with good reliability, the composite data were treated as interval in nature and analysed with parametric techniques including t-tests, ANOVA, factor analysis and multilevel modelling HLM. Any analysis on individual items were treated as ordinal in nature and were analysed using frequencies and non-parametric tests such as chi-square.

Section 4.2.1 Assessing Normality of the Composite Scale Data

To further satisfy the arguments put forward by the cited researchers (Boone & Boone, 2012; Carifio & Perla, 2007; Sullivan & Artino, 2013) that parametric tests can be used on normally distributed Likert data and to satisfy the assumptions underlying parametric tests the normality of the data was assessed. While the Kolmogorov-Smirnov (K-S) presented in Table 4.4 indicates that each scale is not normally distributed (common in large samples), Tabachnick and Fidell (2013) recommend using the histograms to judge normality. A visual inspection of the histograms (Figures 4.1, 2, 3) combined with an examination of the skewness and kurtosis for each factor, indicate distributions that approximate a normal distribution. Further to this, there was no impact on the mean by the presence of outliers in the 'unsafe crossing' and 'dangerous play' composite scales as the trimmed mean was in effect the same as the mean. There were no outliers in the planned protective scale. Therefore, this data is deemed suitable for use with parametric tests.

Table 4.4

Kolmogorov-Smirnov for each ARBQ Scale

	D	df	*P*
Unsafe Crossing	0.07	1100	<.001
Planned Protective Behaviour	0.08	1100	<.001
Dangerous Play	0.11	1100	<.001

When assessing the normality with histograms, the values for asymmetry and kurtosis between -2 and +2 are generally considered acceptable in order to prove normal univariate distribution, however, Hair et al. (2010) and Bryne (2010) argued that data is considered to be normal if skewness is between -2 to +2 and kurtosis is between -7 to +7.

The 'Unsafe Crossing' histogram lies well within a normal curve with a very slight level of positive skew evident (.63) but with the majority of scores falling within one standard deviation (6.19) of the mean (21.95), see Figure 4.1. The 'Planned Protective Behaviour' histogram appears a little flat and illustrates a level of negative kurtosis (-.99) which still falls well within the +/-2 acceptable range. The majority of scores remain within two standard deviations (5.65) of the mean (12.96). See Figure 4.2. The 'Dangerous Play' histogram illustrates some positive skew (.63) with kurtosis of .03. As with the other two scales the majority of the scores fell within one standard deviation (3.55) of the mean (9.88). See Figure 4.3.

Figure 4.1

Histogram of Unsafe Crossing Scale

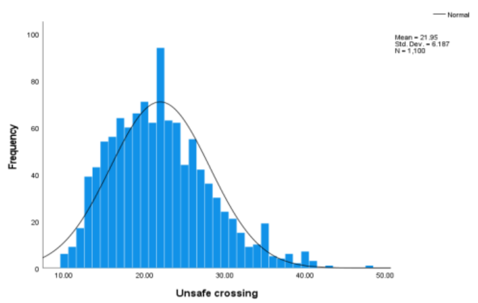


Figure 4.2

Histogram Planned Protective Behaviour Scale

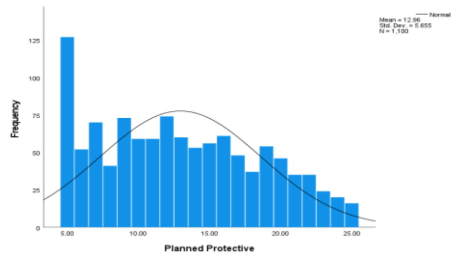
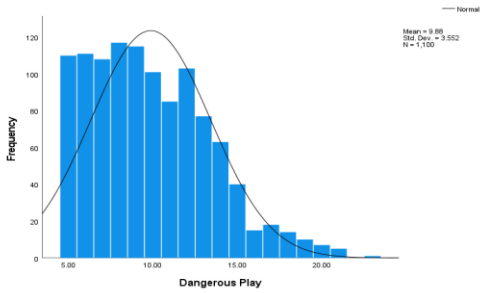


Figure 4. 3

Histogram Dangerous Play



Section 4.2.2 Frequency of Reported Behaviours

To further examine the data the frequency of each item rating was calculated and examined. Likert scales can be subject to distortion through central tendency bias (the avoidance of using extreme categories), social desirability bias (presenting themselves in a favourable light) and acquiescence bias (agreeing with the statements). This was a concern with the ARBQ due to the age profile of the children involved. However, an interrogation of the frequencies would indicate that for each item there were a variety of scores across the Likert scale range and no discernible pattern of selecting *only* extreme or 'sometimes' responses.

It was interesting to note that the children appear to have had no difficulty in selecting the 'hardly ever' and 'sometimes' option which would suggest that they are being honest, as they are reporting on occasion, they have taken some risks when crossing or being out and about on the road (Table 4.5) which may suggest a lack of socially desirable reporting. Similarly, while there have been some examples of 'extreme' reporting in questions relating to dangerous playing on the road (e.g., Hold onto a moving vehicle when riding a bike?) it is plausible due to the age of the sample (11 to 12 years) that they have not participated in those types of dangerous play. This could further be supported by the fact that these items did not load heavily during the factor analysis of this scale and as a result were not included in the final shortened 20-item ARBQ. The use of these extreme responses would also support an honest consideration of their behaviour and therefore, suggest a lack of central tendency bias.

A review of the frequencies highlights some risky behaviour that also needs to be considered in light of their response to the question whether they ever experienced a 'near miss' on the road. As can be seen in Table 4.5 (below), almost half (46.5%) stated they 'hardly ever' experienced a near miss. However, when combined with those who reported 'sometimes' and 'fairly often', 84% self-reported at least one incident of a near miss. A chi-square test of independence was performed to examine the relationship between gender and the self-reporting of a 'near miss' on the road. The relationship between these variables was significant, X^2 (4, N = 1100) = 22.5, $p < .001$, Cramer's V = .143. An examination of the standardised residuals indicated that males were more likely than females to report having 'sometimes', 'fairly often' and 'very often' experienced a near-miss. The effect size was small, and this may be due in part to the very unexpected large numbers of both genders who self-reported having 'sometimes' experienced a near -miss.

Table 4.5

Number of Self-Reported 'Near-Miss' Experience on the Road

	Male		Female		Total	
	N	%	N	%	N	%
Never	72	12.30	102	19.70	174	15.80
Hardly ever	263	45.10	249	48.20	512	46.50
Sometimes	216	37.00	155	30.00	371	33.70
Fairly Often	30	5.10	11	2.10	41	3.70
Very Often	2	0.30	0	0.00	2	0.20
Total	583	100.00	517	100.00	1100	100.00

Table 4.6 sets out the frequency of responses for each behaviour, with items in bold highlighting more risky road crossing behaviour.

Table 4.6

ARBQ 41 Item Frequency of Responses

How often do you…?	Never	Hardly ever	Some-times	Fairly Often	Very Often
Use a lollipop person when one is available?	16.7	15.6	23.5	21.0	23.1
Forget to look properly because you are thinking about something else?	19.4	40.4	31.6	5.9	2.7
Use a mobile phone and forget to look properly?	51.5	27.8	15.4	3.9	1.5
Forget to look properly because you are talking to friends?	22.0	37.5	30.1	7.7	2.6
Cross whether traffic is coming or not thinking that the traffic should stop for you?	49.0	26.9	17.4	4.5	2.2
Not look because can't hear traffic around?	44.6	25.4	20.5	7.0	2.5
Think you have enough time to cross safely but a car is coming faster than you thought?	34.5	34.7	21.6	7.5	1.6
Check to make sure the traffic has completely stopped before you cross at a pedestrian crossing?	3.0	8.5	14.2	33.8	40.5
Climb over barriers or railings that separate the road from the footpath?	62.5	21.0	11.4	3.3	1.9
Wear reflective clothing?	39.8	28.7	19.7	8.6	3.1
Not bother walking to a nearby crossing to cross the road?	19.3	32.6	31.4	11.5	5.3
Look both ways before crossing?	1.2	1.8	7.1	24.9	65.0
Keep looking and listening for traffic until you get all the way across the road?	4.9	13.3	23.5	29.5	28.7
Have to stop quickly or turn back to avoid traffic?	24.6	40.3	23.2	8.3	3.6
Get half way across a road and then have to run the rest of the way to avoid traffic?	14.6	27.7	35.7	14.8	7.1
Cross from between parked cars when there is a safer place to cross nearby?	17.0	29.1	36.9	12.5	4.5
Cross from behind a stationary vehicle that has stopped?	30.5	34.3	24.8	9.2	1.2
Cross without waiting for the 'green man' at a pedestrian crossing?	34.4	29.4	22.2	9.2	4.9

How often do you…?	Never	Hardly ever	Some-times	Fairly Often	Very Often
Cross when can't see both ways very well (like on a bend or top of a hill)?	25.6	39.5	27.5	5.5	1.7
Cross at a place that well light when it is dark so that drivers can see you more easily?	6.9	12.0	24.5	37.2	19.4
Make traffic slow down or stop to let you cross?	26.0	26.4	25.5	14.3	7.9
See a small gap in traffic and 'go for it'?	31.5	30.5	21.8	11.2	5.1
Run across a road without looking because you are in a hurry?	46.4	32.5	13.4	4.4	3.5
Run around in the road (when playing football or other games)?	33.4	25.1	20.5	13.1	8.0
Not notice an approaching car when playing games in the road?	43.4	34.5	16.5	3.5	2.1
Play 'chicken' by deliberately running out in front of traffic?	43.4	34.5	16.5	3.5	2.1
Hold onto a moving vehicle when riding a bike?	91.4	4.5	3.0	0.5	0.6
Hold onto a moving vehicle when on skateboard, scooter, or roller skates?	93.5	3.5	2.2	0.8	0.1
Hang around on the road talking to friends?	38.9	31.7	18.6	6.8	3.9
Ride a scooter, skateboards or roller-skates on the road?	68.1	14.5	10.0	5.0	2.4
Ride out onto the road on scooter, skateboard or roller skates without thinking to check for traffic?	81.1	12.5	4.2	1.8	0.5
Run into the road to get a ball without checking for traffic?	43.9	31.5	16.3	5.3	3.1
Not notice a car pulling out from a driveway or entrance and walk in-front of it?	28.2	44.2	21.9	4.5	1.3
Walk in the road rather than on the footpath?	33.6	40.6	19.9	3.9	1.9
Walk in the road facing the traffic when on roads with no footpath?	36.8	25.0	17.6	8.9	11.6
Deliberately run across the road without looking for a dare?	79.3	13.4	4.8	1.4	1.2
Wear reflective clothing when out on foot in the dark?	34.1	23.3	18.5	13.6	10.5
Walk in single file on roads without footpath?	20.1	20.0	20.5	20.2	19.3

How often do you…?	Never	Hardly ever	Some-times	Fairly Often	Very Often
Wear a cycle helmet when riding a bike?	31.1	13.7	14.6	15.3	25.3
Wear reflective clothing when riding a bike in the dark?	39.7	15.6	15.3	11.3	18.1
Use lights on your bike when it's dark?	29.4	10.3	15.5	17.0	27.9

As per the areas identified in the introduction under cognitive perceptual skill, the following categories have been highlighted for ease of interpretation.

Distraction: Over double of the children reported 'hardly ever' compared to 'never' to the question 'Forget to look properly because you are thinking about something else?'. Other items relating to distraction, such as forgetting to look properly because they are talking to their friends or, are on a mobile phone follow a similar pattern. Table 4.7 sets out the frequency that children walk in the company of their friends on a weekly basis. Thirty nine percent of the children who attend small urban schools and over half of those who attend a large urban school are out on the roads in the company of their friends between 4 and 7 days a week. This increases the chance of crossing while distracted. Distraction is a major concern in pedestrian behaviour due to the serious or fatal consequences of failing to look for oncoming traffic. As discussed in the introduction according to Simmons et al. (2020), distraction is dangerous as it is associated with significantly reduced looks to the left and right before and during crossing, including an increased number of hits and near-misses. This is of particular concern in this sample, although, 65% of the sample reported 'very often' to looking both ways before crossing this reduced to 27% to 'very often' keeping looking and listening until they were all the way across the road. Further to this, almost a third (32%) of those who reported that they 'never' or 'hardly ever 'looked both ways before crossing, reported high levels of distraction by not looking when crossing as they were thinking about something else. These proportions were similar for crossing while talking to friends or on a mobile phone. Therefore, while high numbers reported safe behaviour such as looking both ways before crossing or never forgetting to look because they were on a mobile phone (52%) distraction is still a main concern.

Table 4.7

How Often Walk Every Week with Friends by School Location

	Rural		Small Urban		Large Urban		Total	
	N	%	N	%	N	%	N	%
Never	87	18.80	29	8.30	18	6.30	134	12.20
<Once a week	186	40.10	92	26.30	40	14.00	318	28.90
1-3 Days	108	23.30	91	26.00	74	25.90	273	24.80
4-6 Days	57	12.30	99	28.30	89	31.10	245	22.30
Everyday	26	5.60	39	11.10	65	22.70	130	11.80
Total	464	100.00	350	100.00	286	100.00	1,100	100.00

Risk taking: Questions that relate to their perception of risk and reported risk taking also indicate high levels of unsafe behaviour. For example, 85% reported having to stop quickly and turn around to avoid traffic at least once, with 12% reported this happened fairly to very often. Three quarters (74%) of the children reported making traffic slow down for them to cross with 22% reporting it happened fairly to very often. When asked if they would 'go for it' if they saw a small gap in the traffic, 69% said they have with 16% stating it happened fairly to very often. Other risky behaviours such as crossing from between parked cars or behind stationary vehicles, crossing when they do not have a good line of sight like on a hill and not bothering to walk to a nearby pedestrian crossing all had similarly high frequency of occurrence. Each of these behaviours has a potential to lead to near miss (84% reported so) or an impact. It was also interesting to note that 65% of the children reported cars travelling faster than they thought when trying to cross the road. This would align with the research that suggest a deficit in 11- to 12-year-old children's perceptual ability and hazard perception, see Section 1.3.1 for more details on relevant studies.

The frequency of extreme risk behaviours such holding onto moving vehicles while on a bike or a scooter is low. However, there are quite high instances of extremely dangerous behaviour being reported such as 57% reported to having played chicken with the traffic on the road and 22% reported they have deliberately run across the road without looking for a dare. Therefore, a substantial number of children have reported engaging in the most dangerous road use behaviour. These figures also need to be considered in light of the high level of near misses reported.

Rules of the road: On a more positive note, there would appear to be compliance with some of the rules of the road, e.g., 65% 'very often' looking both ways before crossing, 40.5% very often checking to make sure the traffic has completely stopped before they crossed at a pedestrian crossing. However, over half of the children (55%) reported not looking before crossing as they did not hear traffic. This is a real concern for education as electric vehicles will only increase in number over the coming years. The use of reflective clothing at any stage during the day and at night were low with 40% stating they never wear it when crossing the road and 34% stating they never wear it while crossing the road in the dark. It should be noted that for this age profile (11 to 12 years) there may not be many occasions when they are out after dark either on their own or in the company of adults. Therefore, questions relating to the use of reflective clothing or lights on bikes may not be relevant to them. The use of helmet when cycling was also very low with only a quarter (25%) stating they very often wear one. While some of the 'planned protective behaviour' questions reflected some safe behaviour, the frequency with which the children never or hardly ever walk facing the traffic (62%) or walk in single file on roads with no footpath (40%) indicate a lack of awareness of the rules of the road and how to safely walk without your back to traffic and or two abreast. A further examination of these behaviours by the location of residence rather than school location indicates, over a third of the children who live in the countryside either 'never' or 'hardly ever' walk in single file on a road with no footpath and almost half (45%) of the children who live in either a town or village 'never' or 'hardly ever' walk in single file (Table 4.8). These numbers indicates that children who live in either location are still not fully aware or compliant with a basic rule of the road as a pedestrian. This behaviour makes a pedestrian more vulnerable to oncoming traffic, particularly, on small country roads with poor lines of sight.

When asked how often they walked facing the traffic while on a road with no footpath, over half (51%) of the children who live in the countryside 'never' or 'hardly ever' walk facing the traffic (Table 4.9). Seventy percent of the children who live in the town or village indicate that they never or hardly ever walk facing traffic on a road with no footpath. It should be noted that for both of these questions, it is not possible to assess if the children were answering on the extreme end 'never' due to not having the opportunity to walk on roads with no footpaths. It could be assumed that exposure to these types are roads is more likely in children who live in the countryside.

Table 4. 8

Walk in Single File on Roads with no Footpath by Area of Residence

	Town or village		Countryside		Total	
	N	%	N	%	N	%
Never	139	22.00	82	17.30	221	20.10
Hardly ever	142	22.80	78	16.50	220	20.00
Sometimes	130	20.80	95	20.00	225	20.50
Fairly Often	114	18.30	108	22.80	222	20.20
Very Often	101	16.20	111	23.40	212	19.30
Total	626	100.00	474	100.00	1100	100.00

Table 4.9

Walk Facing the Traffic on Road with no Footpath by Area of Residence

	Town or Village		Countryside		Total	
	N	%	N	%	N	%
Never	268	42.80	137	28.90	405	36.80
Hardly ever	170	27.20	105	22.20	275	25.00
Sometimes	98	15.70	96	20.30	194	17.70
Fairly Often	49	7.90	49	10.30	98	8.90
Very Often	41	6.40	87	18.40	128	11.60
Total	626	100.00	474	100.00	1100	100.00

Another factor that needs to be considered is how often children are accompanied by adults rather than being with friends or on their own. Only 19% of the children stated they are ‘never’ out on the roads on their own and only 8% said they are never out with adults (Table 4.10). Adults are in the position to model the rules of the road, thereby educating children on the safest position to be on a road when no footpaths are available or when to walk in single file. As to be expected with children in this age group (11 to 12 years), children are very often accompanied by adults with over a third in both the urban and countryside walking with adults 1 -3 days a week. These are opportunities for parents and adults to model appropriate road use behaviour in this age group and foster a family climate of road safety.

Table 4.10

Frequency of Walking Accompanied by Adult by Area of Residence

	Town or Village		Countryside		Total	
	N	%	N	%	N	%
Never	56	8.90	30	6.30	86	7.80
<Once a week	186	29.70	150	31.60	336	30.50
1-3 Days	234	37.40	175	36.90	409	37.20
4-6 Days	90	14.40	78	16.50	168	15.30
Everyday	60	9.60	41	8.60	101	9.20
Total	626	100.00	474	100.00	1100	100.00

Section 4.2.3 Discussion on Reported Behaviour

An analysis of the frequency of self-reported behaviours in Section 4. 2.2 indicated high levels of distraction through crossing the street using a mobile (48%) and forgetting to look properly. The high level of mobile phone evident in this sample is a concern due to the limited attentional skills that are still being developed in ages 9–11 age group putting them at greater risk than adults when they attempt to cross a road distracted (Doyle, 1973). While these children were aged between 11 to 12 years, developmentally, they have still not reached adult level of attention and skill. Tabibi and Pfeffer (2007) found no significant difference between the older children and adults in their ability to identify safe sites, however there was a significant difference in the time taken to identify them, with 10 to11-year-olds taking much longer than adults in all conditions.

However, even within adults, using a mobile phone can lead to ‘inattentional blindness’, affects walking speed (Nasar et al., 2008), causes more missed opportunities to cross (Tapiro et al., 2020) and more violations when crossing including crossing against red traffic lights (Zhou et al., 2019). While there is some conflict within the literature on whether texting (Schwebel et al., 2012), talking (Pešić et al., 2016) or listening to music causes more distraction, the research clearly finds that it leads to a reduction in visual scanning (Feld & Plummer, 2019) impacting walking by decreasing its speed and increasing response time to traffic information (Wang et al., 2022) including car horn and traffic lights (Schwebel et al., 2012). As the research has indicated such significant impairments in young adult pedestrian behaviour while distracted with a mobile phone, it will inevitably result in similar if not worse impact on attention in children aged 11 to 12 years.

A study by Stavrinos et al. (2009) found 10 to 11-year-olds who completed simulated road crossings in an immersive, interactive virtual pedestrian environment while distracted by a mobile phone were less attentive to traffic, left less safe time between their crossing and the next arriving vehicle, experienced more collisions and close calls with oncoming traffic, and waited longer before beginning to cross the street. Similarly, Tapiro et al. (2018) studied children aged 7–13 and adults who viewed 20 simulated crossing scenarios, embedded with visual and auditory (mobile phone calls) distractions. The 11- to 13-year-old children demonstrated very similar road crossing behaviour to adults, as expressed in the safety gap measure and the visual attention distribution, which might suggest they can cross the road by themselves, however, they demonstrated slower response to a crossing opportunity. As it was set out earlier, this time delay entering the road can have severe consequences. Therefore, the combination of increased attentional demands and less experience with traffic places young adolescents and children at greater risk when distracted.

It was interesting to note that 84% of the children indicated that they had at least one near-miss incident, with males more likely to experienced one with greater frequency than females. While it is not possible to ascertain if they were on their mobile phone at the time or delayed their entry onto the road-way due to the resultant distraction, they are a population with already high use of mobile phones and are at an increased risk for adverse events on the road due to the likelihood of increased use as their age increases.

An even higher level of distraction reported was forgetting to look because they were walking with friends or thinking about something else. Whereas 50% of the children said they never used a mobile phone while crossing only 22% of the children reported never when asked about crossing distracted with friends. Approximately 40% said they did so with some frequency. According to O'Neal et al. (2019) crossing roads with others represents a particularly challenging task for children and adolescents, due to the increased complexity of joint decision making and the social influences on risk taking. Adult pedestrians were found more likely to cross against a red light when others do, indicative of the flock mentality where people blindly follow the actions of other. Specific to this age group, O'Neal et al. (2019) examined how crossing roads with a friend versus alone affects gap decisions and movement timing in 12-year-olds and adults. Their resulted indicated that pairs of adolescent friends exhibited riskier road crossing behaviour than pairs of adult friends. The pairs of 12-year-olds adjusted their movement timing by entering and crossing the road more quickly to compensate for their less discriminating gap choices. The main conclusion was that compared to adults, young adolescents took riskier gaps in traffic when crossing virtual roads with a friend than when crossing alone. Given the high number of near miss events recorded in this sample, the impact of crossing while distracted with friends may pose a significant risk to road safety in early adolescence. Key areas of concern would be adolescents choosing to cross through the same gap together or choosing risky gaps that are too small to accommodate them at the same time. Adolescents may also misinterpret movement or verbal cues from friends, leading the first crosser to choose an unsafe gap for crossing (O'Neal, 2019). Similarly, Zhou and Horrey's (2010) research indicated that people often follow other pedestrians when crossing the road, even if they are not convinced about their safety of doing so and within this age-group, the impact of peer influence can't be underestimated. The opportunity for distracted crossing while in the company of friends is quite high for children in urban locations as thirty nine percent of the children who attended small urban schools and over half of those who attended a large urban school are out on the roads in the company of their friends between 4 and 7 days a week.

Questions that related to their reported risk taking also indicate high levels of unsafe behaviour. Three quarters (74%) of the children reported making traffic slow down for them to cross with 22% reporting it happened fairly to very often. When asked if they would 'go for it' if they saw a small gap in the traffic, 69% said they have with 16% stating it happened fairly to very often. Children of 11 to 12 years' ability to accurately assess gaps as per Gibson's (1979) theory of perception is still in development and not at adult skill level. Stafford et al. (2022) who looked at action-based decisions in relation to fast-moving objects like motor vehicles in the environment has shown that 'affordance perception' continues to change and develop even in late childhood and early adolescence (Chihak et al., 2010; Plumert & Kearney, 2018). Consistently, the research has indicated with the aid of bicycle simulators that due to immaturity in their perceptual development, children of 10 to 12 had less time to spare than adults when they passed through a gap in traffic (Chihak et al. 2010; Plumert & Kearney , 2011; 2014) and that while 11-year-olds have a relatively good spatial orientation compared to older children (15–18 years old) and adults, they react more slowly and are also less competent to consider the speed, distance, and acceleration of multiple vehicles from multiple directions, as well as the speed at which they can physically cross a pedestrian crossing (Barton and Schwebel, 2007). A further concern is when children are crossing multiple lanes of traffic such as they may be exposed to in large urban areas. Judging the time to cross multiple lanes of traffic is particularly challenging because the gaps approach from opposite directions and the slower decision making can have serious consequences, as according to Plumert and Kearney (2014), time spent judging the ability to cross one gap takes away from time available to judge the next gap. There must be sufficient time to carry out actions following a decision to cross, and the action of crossing must be initiated at the right time as errors can result when the window for action is too tight or when the timing of action is insufficiently precise (or both). Grechkin et al. (2013) monitored 12- and 14-year-olds and adult's gap selection and indicated that when faced with multiple lanes of traffic, two types of scenarios can emerge. When the far gap opens before or with the near gap, the window for action appears as a single "aligned" gap spanning both lanes of traffic. On the other hand, in a "rolling" gap, the near-lane gap opens before the far-lane gap allowing pedestrians to begin crossing before the far-lane gap has opened. They found that all age groups exhibited a preference for rolling over aligned gaps, despite its difficulty as it gave them more time to cross, but noted in particular, children had significantly less time to spare than adults when they crossed an aligned pair. Therefore, in situations like this their option is seeing a full gap and going for it or start to cross while traffic is oncoming and hoping to get across fully without having to turn back as the car on the far side is coming faster than they thought. In this sample, 85% reported having to stop quickly and turn around to avoid traffic at least once, with 12% reported this happened fairly to very often. This is why it is safer for children at this age to used controlled crossings when one is available in order to avoid a near-miss or collision.

It could be argued that this research is based on cycling simulators and is therefore, not applicable to all children. However, O'Neal et al. (2018) focused on six to 14-year-olds and adults road crossing with a large-screen, immersive pedestrian simulator. They found younger children were less discriminating than older children and adults, choosing fewer large gaps and more small gaps. However, 12-year-olds' gap choices were significantly more conservative than those of 6, 8, 10, and 14-year-olds, and adults. The timing of entry behind the lead vehicle in the gap (a key measure of movement coordination) did not reach adult like levels until the age of 14. This would appear to support the findings from the cycling simulator studies. Therefore, the majority of research to date on 11 to 12-year-old children's ability to accurately assess gaps in either single lane or multiple lane traffic ability consistently point to challenges in their ability to safely 'carry off' impulsive actions like seeing gaps in traffic and going for it without negative consequences.

While it is to be expected that due to the lower level of experience than adults and the impact of walking with friends distracted, an occasional near miss event will be encountered. However, in this sample as per Table 4.6, these children were demonstrating higher frequency of reporting that would indicate higher risk taking, perhaps reflective of an over estimation of their own ability.

Other risky behaviours such as crossing from between parked cars or behind stationary vehicles was recorded frequently, however, their smaller physiques make children more vulnerable to severe injuries and make them less detectable from roadside obstructions (Stevenson et al., 2015). Children of this age may not have the perceptual ability to accurately assess hazardous situations like crossing from behind stationary or parked vehicle. A key difference between adults and children are that adults tend to identify both materialised road and unmaterialised road hazards whereas child-pedestrians tend to identify mainly materialised hazards and are poor at identifying unmaterialised such as being blocked from view behind a parked car (Borowsky & Oron-Gilad, 2013; Meir et al., 2013; 2015;2015a). A study which examined adults and 7–13-year-olds' pedestrian hazard perception skills in complex traffic scenes found that adults tended to rate photographs depicting field of view partially obscured by parked vehicles, and vehicles closer to the crossing site as more hazardous (Meir et al., 2020). The high frequency of crossing when they did not have a good line of sight like on a bend or top of a hill was also surprising given their age. Tolmie et al, (1996) suggested based on research by Ampofo-Boateng and Thomson (1991) that from about 9 years of age children begin to appreciate that the brow of a hill or an obscured bend with overhanging trees and bushes is a dangerous place to cross the road. While all children mature at a different rate the level of reporting here may indicate that children between 11 and 12 are still not perceptually sophisticated enough to identify these as hazardous situations. On the other hand, they may also be a result of more developed propensity to take risk.

A poor perception of the oncoming speed of traffic was also evident in the children's self-reported road crossing. For example, 85% reported having to stop quickly and turn around to avoid traffic at least once, with 12% reported this happened fairly to very often. It was also interesting to note that 65% of the children reported cars travelling faster than they thought when trying to cross the road. This would align with the research that suggest vehicle distance is used more often than speed by children judging traffic safety (Connelly et al., 1998; Morrongiello et al., 2016; Oxley et al., 2005; Simpson et al., 2003). Another factor to consider in this age group is that according to research, younger children tend not to look at gaps at all, concentrating instead on individual vehicles, the vehicle's model or colour, rather than relevant variables, such as its speed, distance, or direction of travel (Tolmie et al. 1998).

Section 4.2.4 Comparison of Means Across Countries

Table 4.11 sets out the means and standard deviations, presented in terms of decreasing mean values ranked in descending order by the mean value of the 41 items in the Irish scale alongside the corresponding data from the UK, Spain. Belgium, New

Zealand, Iran, China. It should be noted again that two questions relating to alcohol use and playing chicken were removed due to the age of the sample. However, none of these items were ranked in the top behaviours across any of the countries included in this cross-country comparison. It should be further noted that the Irish sample is the only sample containing *just* 11 -12-year-olds. This may have an impact on the ranking for some behaviours as all of the other studies have a wider spread of ages up to and including 18 years with some starting only at 13-14 years. The level of autonomy on the roads, the frequency with which children of this age may be out after dark and the engagement in high-risk behaviour would most likely be different from those in the older adolescent age-groups.

As can be seen in Table 4.11 there are similarities in the mean ordering of the 41 behaviours with the six previously studied countries. The top three and lowest five are fairly consistent across each, in particular across the European countries. The most frequently reported behaviours were those that demonstrated desirable road safety behaviour such as ‘Look both ways before crossing’ (rank = 1), ‘Check to make sure traffic completely stopped before cross at pedestrian lights’ (rank = 2) and ‘Keep looking and listening for traffic’ (rank =3). The first and second highest ranked questions were the same across the UK, Spain, Belgium and New Zealand. Only ‘Look both ways before crossing’ was the same across all countries. In general, the majority of the same behaviours appeared in the top ten rankings across the studies with regard to pedestrian behaviour. The main point of difference lay in the cycling behaviours. It can also be noted that China had quite low rankings for some higher risk pedestrian behaviours such as getting half-way across the road and having to turn back and crossing from between parked cars. The authors themselves noted that while there were some commonalities in the ranking of specific road use behaviours across all counties studied, the more cautious behaviours reported in their sample may be culturally driven due to the collective Chinese culture which greatly values conformity, social obligation and group harmony (Wang et al., 2019). It should also be highlighted that some of the high ranking in the Iranian sample around very high risk behaviours such as seeing a gap in traffic, crossing behind stationary vehicles, having to stop and turn around to avoid being hit is reflective of the much higher rate of death on Iranian roads compared to the other counties studied, such as rates up to 20 times higher than in the UK (Nabipour et al, 2015).

The five least frequently reported behaviours were very similar across all countries including Ireland, despite the difference in the age ranges across studies and included extreme risk behaviours such as holding onto moving vehicles, running across the road for a dare or playing chicken with the traffic.

Table 4.11

Rank, Mean and Standard Deviation of 41- Item ARBQ, Ireland, UK, Spain, Belgium, New Zealand, Iran and China.

Item	Question	Ireland			UK			Belgium			Spain			New Zealand			Iran			China		
		R	M	SD	R	M	SD	R	M	SD	R	M	SD	R	M	SD	R	M	SD	R	M	SD
12	Look both ways before crossing?	**1**	4.51	0.80	**1**	4.08	1.07	**1**	4.17	0.95	**1**	4.07	1.08	**1**	4.17	0.95	**1**	4.21	1.13	**1**	4.26	1.19
8	Check to make sure the traffic has completely stopped before you cross at a pedestrian crossing?	**2**	4	1.08	**2**	3.46	1.3	**2**	3.87	1.05	**2**	3.76	1.15	**2**	3.73	1.15	**3**	3.42	1.34	**3**	4.17	1.15
13	Keep looking and listening for traffic until you get all the way across the road?	**3**	3.64	1.17	**4**	3.26	1.26	**3**	3.55	1.14	**4**	3.34	1.24	**5**	3.24	1.17	**5**	3.32	1.4	**2**	4.23	1.13
20	Cross at a place that well light when it is dark so that drivers can see you more easily?	**4**	3.5	1.14	**3**	3.32	1.16	**5**	3.36	1.06	**3**	3.48	1.18	**7**	3.13	1.08	**2**	3.5	1.35	**4**	3.79	1.36
1	Use lollipop person when one is available?	**5**	3.18	1.39	**26**	2.06	1.2	**4**	3.45	1.27	**6**	2.92	1.35	**4**	3.27	1.27	**22**	2.27	1.36	**5**	2.73	1.44
41	Use lights on your bike when it's dark?	**6**	3.04	1.61	**5**	2.84	162	**6**	3.11	1.53	**19**	2.37	1.56	**15**	2.64	1.53	**21**	2.28	1.61	**5**	2.73	1.64
38	Walk in single file on roads without footpath?	**7**	2.99	1.41	**11**	2.54	1.38	**10**	2.86	1.29	**10**	2.81	1.41	**20**	2.4	1.16	**6**	3.06	1.41	**7**	2.67	1.43
39	Wear a cycle helmet when riding a bike?	**8**	2.9	1.59	**27**	2.03	1.4	**7**	3.07	1.59	**26**	2.03	1.41	**3**	3.7	1.4	**31**	1.94	1.38	**11**	2.17	1.44
15	Get half way across a road and then have to run the rest of the way to avoid traffic?	**9**	2.72	1.11	**6**	2.82	1.14	**11**	2.74	1.04	**8**	2.88	1.04	**9**	3.01	1.04	**7**	2.9	1.38	**21**	1.72	0.97
16	Cross from between parked cars when there is a safer place to cross nearby?	**10**	2.58	1.05	**9**	2.66	1.16	**12**	2.7	0.99	**7**	2.92	1.07	**11**	2.88	1.03	**10**	2.68	1.3	**25**	1.56	0.87
40	Wear reflective clothing when riding a bike in the dark?	**11**	2.52	1.54	**35**	1.79	1.24	**23**	2.22	1.38	**31**	1.78	1.23	**30**	1.95	1.26	**18**	2.35	1.44	**20**	1.74	1.09
21	Make traffic slow down or stop to let you cross?	**12**	2.52	1.24	**15**	2.43	1.24	**9**	2.85	1.19	**14**	2.66	1.14	**24**	2.22	1.05	**13**	2.57	1.36	**9**	2.39	1.35
11	Not bother walking to a nearby crossing to cross the road?	**13**	2.51	1.09	**7**	2.72	1.22	**13**	2.66	1.05	**9**	2.85	1.14	**8**	3.1	1.13	**12**	2.58	1.36	**10**	2.22	1.3
37	Wear reflective clothing when out on foot in the dark?	**14**	2.43	1.35	**36**	1.67	1.07	**31**	2	1.22	**35**	1.58	1	**32**	1.69	1.04	**23**	2.25	1.37	**16**	1.86	1.17
24	Run around in the road (when playing football or other games)?	**15**	2.37	1.28	**22**	2.24	1.29	**27**	2.14	1.16	**30**	1.8	1.04	**25**	2.21	1.14	**36**	1.58	1.09	**33**	1.36	0.75

35	Walk in the road facing the traffic when on roads with no footpath?	**16**	2.34	1.36	**12**	2.51	1.36	**8**	2.97	1.17	**17**	2.51	1.23	**10**	2.89	1.19	**20**	2.32	1.28	**16**	1.86	1.2
2	Forget to look properly because you are thinking about something else?	**17**	2.32	0.95	**14**	2.44	1.08	**18**	2.57	1.08	**18**	2.46	1.01	**15**	2.47	0.99	**19**	2.33	1.22	**23**	1.61	0.87
4	Forget to look properly because you are talking to friends?	**18**	2.31	0.98	**10**	2.65	1.15	**19**	2.57	1.16	**5**	3.05	1.12	**13**	2.8	1.06	**15**	2.45	1.35	**15**	1.88	0.98
22	See a small gap in traffic and 'go for it'?	**19**	2.28	1.17	**8**	2.69	1.3	**20**	2.56	1.13	**13**	2.73	1.13	**6**	3.14	1.08	**4**	3.35	1.36	**26**	1.53	0.86
14	Have to stop quickly or turn back to avoid traffic?	**20**	2.26	1.03	**19**	2.34	1.07	**30**	2.06	0.91	**22**	2.27	1.01	**23**	2.23	0.94	**8**	2.87	1.31	**8**	2.53	1.38
18	Cross without waiting for the 'green man' at a pedestrian crossing?	**21**	2.21	1.15	**17**	2.35	1.17	**21**	2.50	1.23	**12**	2.79	1.12	**18**	2.42	1.23	**14**	2.46	1.4	**24**	1.58	0.88
19	Cross when can't see both ways very well (like on a bend or top of a hill)?	**22**	2.18	0.97	**13**	2.49	1.1	**16**	2.59	1.01	**23**	2.25	0.96	**16**	2.45	0.94	**17**	2.38	1.29	**12**	2.14	1.19
17	Cross from behind a stationary vehicle that has stopped?	**23**	2.16	1.01	**16**	2.35	1.17	**14**	2.64	1.0	**11**	2.79	1.12	**12**	2.83	1.05	**9**	2.77	1.27	**14**	1.99	1.15
7	Think you have enough time to cross safely but a car is coming faster than you thought?	**24**	2.07	1.00	**18**	2.34	1.12	**26**	2.16	0.94	**24**	2.17	0.98	**21**	2.38	0.92	**11**	2.59	1.17	**16**	1.86	1.01
33	Not notice a car pulling out from a driveway or entrance and walk in-front of it?	**25**	2.06	0.89	**24**	2.2	1.03	**28**	2.13	0.90	**20**	2.36	1.09	**22**	2.30	1.03	**16**	2.43	1.11	**27**	1.48	0.81
10	Wear reflective clothes?	**26**	2.06	1.10	**39**	1.49	0.93	**33**	1.90	1.05	**38**	1.41	0.8	**33**	1.60	0.91	**30**	2.05	1.27	**16**	1.86	1.08
29	Hang around on the road talking to friends?	**27**	2.05	1.09	**20**	2.27	1.23	**24**	2.19	1.12	**29**	1.9	1	**17**	2.43	1.15	**35**	1.66	1.12	**13**	2.01	1.16
34	Walk in the road rather than on the footpath?	**28**	2	0.93	**23**	2.22	1.07	**22**	2.45	0.96	**21**	2.29	0.96	**19**	2.41	1.0	**25**	2.21	1.30	**27**	1.48	0.84
6	Not look because you can't hear any traffic around?	**29**	1.97	1.08	**21**	2.25	1.22	**17**	2.58	1.17	**15**	2.59	1.23	**14**	2.65	1.16	**27**	2.14	1.31	**31**	1.39	0.73
32	Run into the road to get a ball without checking for traffic?	**30**	1.92	1.04	**32**	1.87	1.09	**36**	1.81	0.87	**33**	1.76	0.95	**35**	1.83	0.96	**38**	1.56	1.00	**36**	1.27	0.65
25	Not notice an approaching car when playing games in the road?	**31**	1.86	0.95	**31**	1.93	1.11	**34**	1.88	0.99	**32**	1.76	0.93	**26**	2.21	1.24	**33**	1.69	1.11	**29**	1.44	0.81
23	Run across a road without looking because you are in a hurry?	**32**	1.86	1.03	**25**	2.2	1.22	**35**	1.86	0.97	**25**	2.17	1.07	**28**	2.1	1.04	**28**	2.13	1.2	**22**	1.62	0.88
5	Cross whether traffic is coming or not thinking that the traffic should stop for you?	**33**	1.84	1.01	**29**	1.99	1.21	**15**	2.62	1.13	**16**	2.55	1.23	**27**	2.15	1.12	**29**	2.09	1.28	**30**	1.41	0.78
3	Use a mobile phone and forget to look properly?	**34**	1.76	0.95	**28**	2.03	1.15	**25**	2.17	1.22	**27**	2.01	1.04	**29**	2.07	1.15	**24**	2.24	1.21	**32**	1.37	0.77
9	Climb over barriers or railings that separate the road from the footpath?	**35**	1.61	0.94	**30**	1.97	1.21	**32**	1.91	1.05	**28**	1.95	1.08	**31**	1.94	1.09	**26**	2.21	1.18	**34**	1.32	0.69

30	Ride a scooter, skateboards or roller-skates on the road?	**36**	1.59	1.01	**34**	1.85	1.26	**29**	2.08	1.17	**34**	1.72	1.04	**36**	1.68	1.05	**32**	1.71	1.17	**35**	1.3	0.72
36	Deliberately run across the road without looking for a dare?	**37**	1.32	0.73	**37**	1.51	0.95	**41**	1.30	0.72	**42**	1.24	0.66	**42**	1.34	0.81	**34**	1.69	1.04	**37**	1.21	0.62
31	Ride out onto the road on scooter, skateboard or roller skates without thinking to check for traffic?	**38**	1.28	0.67	**38**	1.5	0.95	**38**	1.57	0.9	**39**	1.31	0.71	**38**	1.36	0.73	**37**	1.57	1.11	**38**	1.21	0.61
26	Play 'chicken' by deliberately running out in front of traffic?	**39**	1.16	0.53	**42**	1.36	0.88	**42**	1.25	0.61	**43**	1.23	0.68	**43**	1.33	0.77	**41**	1.5	1.03	**41**	1.12	0.47
27	Hold onto a moving vehicle when riding a bike?	**40**	1.15	0.54	**41**	1.36	0.89	**39**	1.48	0.87	**37**	1.42	0.92	**39**	1.36	0.82	**39**	1.52	1.04	**39**	1.2	0.68
28	Hold onto a moving vehicle when on skateboard, scooter, or roller skates?	**41**	1.11	0.45	**40**	1.38	0.91	**40**	1.47	0.85	**41**	1.24	0.68	**40**	1.35	0.81	**40**	1.5	1.1	**40**	1.41	0.49

R is rank out of 41 assigned the item when the data were ranked ordered in terms of mean response within their sample of origin. No is the number that was assigned to the item within the original measure, after two items were removed.

Section 4.3 Demographic Analysis

To gain a further understanding of the behaviours of the children in this sample and to facilitate comparison with the previous ARBQ studies, the following analyses is based on the composite mean scores for each factor on the shortened 20 item scale (Table 4.2). According to Tabachnick and Fidell (2001), this method is acceptable as it preserves the variation in the original data. While the items in each composite scale may vary slightly in each country there is sufficiently similar content in each factor to imply very similar road use behaviour (see Table 4.12). For 'Unsafe Crossing', the Irish scale contained ten rather than eight items with seven items the same across all other studies (Table 4.12). Of note is the inclusion in Ireland of the distracted crossing due to use of a mobile phone in Ireland, not reflected in the other studies. This may be due to the steadily increasing use of mobile phones across all age groups but in particular the 11-to-12-year age group. All items in the 'Planned Protective Behaviour' scale were the same across each study with the biggest discrepancy in the 'Dangerous Play' scale. This scale had only one item in common across all the studies. This may be attributed to the age profile in question as the Irish study only surveyed 11- to 12-year-olds.

The items in the Irish scale reflect more age-appropriate behaviour such as playing games on the road with friends and may also reflect a lack of more extreme risk-taking behaviour that is generally more attributable to the older age groups. As per Section1.3, Salducco et al., (2022) found that risky pedestrian behaviours were more widespread among ninth grade students (14 years) than seventh grade (12 years) and those who were more independent. Consistently, across each of the ARBQ studies, children in lower age groups displayed less high risk or dangerous behaviour such as playing chicken with oncoming traffic and running across the road deliberately for a dare (items comprising the dangerous playing factor). Therefore, when examining the demographic comparisons on the dangerous play scale, the restricted age range will need to be considered.

Table 4.12

ARBQ 20 Item Scale Content Compared to UK, Spain, Belgium, New Zealand and Iran

Item (How often do you. . .)	
Unsafe Crossing	
Forget to look properly talking to friends	Same across all countries
Forget to look properly because thinking about something else	Same across all countries
Run across a road without looking because in a hurry	Same across all countries
Think have enough time to cross but car faster than thought	All except New Zealand
Get halfway across and then have to run rest of way	Same across all countries
See a small gap in traffic and go for it	Same across all countries
Cross from between parked cars when safer place nearby	Same across all countries
Use mobile phone and forget to look properly	Unique to Ireland
Not look because can't hear traffic	Unique to Ireland
Not notice a car pulling out from driveway and walk in front of it	Unique to Ireland
Planned Protective Behaviour	
Wear reflective clothing when riding a bike	Same across all countries
Wear reflective clothing when out on foot in dark	Same across all countries
Wear reflective clothes	Same across all countries
Wear a cycle helmet when riding a bike	Same across all countries
Use lights on bike when dark	Same across all countries
Dangerous Playing on Road	
Run around road when playing games	Unique to Ireland
Hang around on road talking to friends	Unique to Ireland
Not notice an approaching car when playing on road	Unique to Ireland
Ride a scooter, skateboard or roller skates on road	Same across all countries
Walk in the road rather than on footpath	Unique to Ireland

* No information on the items used to create composite scales in the Chinese study

Section 4.3.1 Normality of the Data

An earlier assessment of the normality for each composite scale indicated data approximating a normal distribution. Prior to running the analysis an examination of the data suitability also indicated that for each subgroup the data approximated the normal distribution. Homogeneity of variance was assessed using Levene's Test for Equality of Variances. To satisfy the assumption of homogeneity of variance, the *p*-value for Levene's Test should greater than .05. Where a *p*-value of less than .05 was reported, then the assumption of homogeneity of variance has been violated and a stricter alpha level of .01 was implemented to evaluate the results (Pallant, 2020).

Section 4.3.2 ANOVA Analysis

The impact of gender, previous road safety education and school location on the ARBQ scales was investigated. This research was interested in assessing if interactions existed between the variables, therefore, a series of three-way ANOVAs were used to determine the effect of the three independent variables (gender, education and location) on the dependent variables ‘Unsafe Crossing’, ‘Planned Protective Behaviour’ and ‘Dangerous Play’. While age was also a significant factor in the previous research, this sample contained only 11- to 12-year-old children. As this is a very restricted age range, it was considered unlikely that there would be any difference in the reported behaviours between the two age groups. However, this assumption was formally tested before exclusion. All main effects and interactions were examined along with effect sizes as recommended by Cortina and Nouri (2000). All significant main effects with three or more levels will be explored post hoc using Tukey HSD. Investigation of significant interactions will employ an analysis of simple effects along with visual inspection to guide the process.

Unsafe Crossing

To rule out the inclusion of age in the ANOVA analysis, a t-test was conducted to compare ‘unsafe crossing’ behaviour scores for 11- and 12-year-olds. There was no significant difference between the 11 year old (M =2.14, *SD* = 0.59) and 12 year olds (*M* = 2.15, *SD* = .57); *t*(1098) = -.14, *p* = .89, two-tailed). The magnitude of mean difference (-.007, 95% CI [-.11, .09]) was very small (eta squared = -.01). Therefore, age was not included in any of the subsequent analysis.

The result of the Levenes test indicated the variance between the groups were not equal, F (9,1090) = 3.26, $p < .001$. Therefore, the more stringent alpha of .01 was set to interpret any main effects or interactions. Higher mean scores represent greater unsafe road crossing behaviour.

There was a significant main effect for gender, F (1,1090) = 9.66, $p = .002$, $\eta_p^2 = .009$ indicating a small effect size. Males (M = 2.21, SD = .56) engaged in significantly more unsafe crossing than females (M = 2.08, SD = .56). There was a significant main effect of prior road safety education, F (1,1090) = 25.38, $p < .001$, $\eta_p^2 = .02$ indicating a small effect size. Those who had prior road safety education (M = 2.19, SD = .56) reported more unsafe crossing than those who did not have prior education (M = 2.11, SD = .56). There was a significant main effect of school location, F (2,1090) = 30.3, $p < .001$, $\eta_p^2 = .05$ indicating a medium effect size. Post hoc analysis with Tukey HSD demonstrated that children in rural schools (M = 2.04, SD = .53) reported significantly less unsafe road crossing than those in small urban (M = 2.21, SD = .57) or Large urban (M = 2.24, SD = .57) schools. There was no significant difference in reported unsafe crossing behaviour between those in small or large urban schools. There were no significant interactions, see Table 4.13.

Table 4. 13

ANOVA Unsafe Crossing

	Sum of Squares	df	*F*	*p*	η_p^2
Gender	2.85	1	9.66	0.002	0.01
Education	7.48	1	25.38	<.001	0.02
Location	17.70	2	30.04	<.001	0.05
Education * Location	0.00	1	0.01	0.92	0.00
Education * Gender	0.02	1	0.05	0.82	0.00
Location * Gender	1.72	2	2.91	0.06	0.01
Education * Location * Gender	0.39	1	1.32	0.25	0.00

Planned Protective Behaviour

To rule out the inclusion of age in the ANOVA analysis, a t-test was conducted to compare 'planned protective' behaviour scores for 11- and 12-year-olds. There was no significant difference between the 11 year old (*M* = 2.83, *SD* = 1.05) and 12 year olds (M = 2.77, *SD* = .95); *t*(1098) = .62, *p* = .53, two-tailed). The magnitude of mean difference (.05, 95% CI [-.11, .22]) was very small (eta squared = .06). Therefore, age was excluded from the following analysis. The result of the Levenes test indicated the variance between the groups were not equal, *F* (9,1090) = 3.44, *p* < .001. Therefore, the more stringent alpha of .01 was set to interpret any main effects or interactions. Higher mean scores represent greater planned protective behaviour.

There was a significant main effect for gender, *F* (1,1090) = 12.86, *p* <.001, η_p^2 = .01 indicating a small effect size. Females (*M* = 2.91, *SD* = 1.0) reported significantly more planned protective behaviour than males (*M* = 2.66, *SD* = .90). There was a significant main effect of prior road safety education, *F* (1,1090) = 9.77, *p* = .002, η_p^2= .01 indicating a small effect size. Those who had prior road safety education (*M* = 2.88, *SD* = .98) reported more planned protective behaviour than those who did not have prior education (*M* = 2.7, *SD* = .94). There was a significant main effect of school location, *F* (2,1090) = 74.43, *p* <.001, η_p^2= .12 indicating a large effect size. The children who attend rural schools (*M* = 3.15, *SD* = .99) reported significantly more planned protective behaviour than those in either a small urban (*M* = 2.45, *SD* = .82) or large urban area (*M* = 2.57, *SD* = .85). There was no difference between small or large urban areas. However, these main effects of gender and location need to be interpreted in light of the significant interactions between gender and location, *F* (2,1090) = 15.49, p < .001, η_p^2 =.03 (Tables 4.14, 4.15; Figure 4.4).

Analysis of simple effects found significant differences between males and females at each level of school location (*p* <.001). However, the location effects for male and females were different. Females who attended rural and small urban schools reported significantly (*p* < .001) more planned protective behaviour than males but significantly less (*p* < .001) than males when attending large urban schools. Males who attended small urban schools reported significantly less planned protective behaviour than those who attended a large urban school (*p* < .001). By contrast, females who attended small urban schools reported significantly more planned protective behaviour than when attending a large urban school, see Figure 4.4 and Table 4.15 for the means and SD for each group in analysis of simple effects.

Table 4.14

ANOVA Planned Protective Behaviour

	Sum of Squares	df	*F*	*p*	η_p^2
Gender	9.94	1	12.86	<.001	0.01
Education	7.55	1	9.77	0.002	0.01
Location	114.99	2	74.43	<.001	0.12
Education * Location	4.99	1	6.46	0.02*	0.01
Education * Gender	2.59	1	3.35	0.067	0.00
Location * Gender	25.48	2	16.49	<.001	0.03
Education * Location * Gender	0.03	1	0.03	0.855	0.00

**alpha set at .01 due to heterogeneity of variance*

Figure 4. 4

Interaction Between Gender and School location for Planned Protective Behaviour

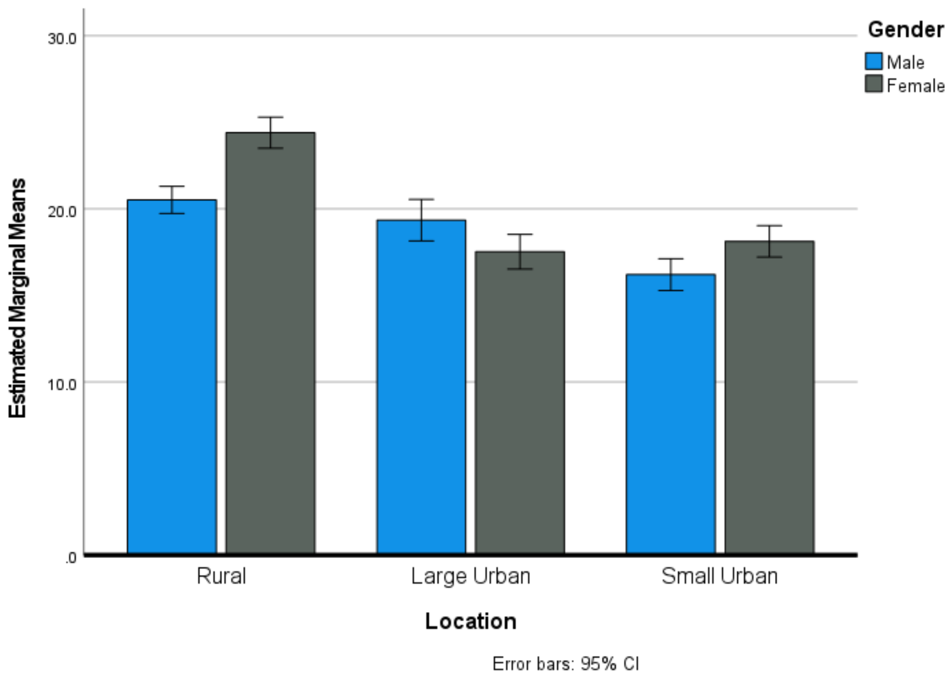


Table 4.15

Means, SDS and Analysis of Simple Effects for Planned Protective Behaviour

		Mean	SD	Sum of Squares	df	F	P	η_p^2
Male				38.65	2	25.02	<.001	.04
	Rural	2.93	0.06					
	Large Urban	2.76	0.09					
	Small Urban	2.32a	0.07					
Female				101.34	2	65.59	<.001	.11
	Rural	3.48	0.07					
	Large Urban	2.50	0.07					
	Small Urban	2.59a	0.06					

** a Based on modified population marginal mean.*

Dangerous Play

To rule out the inclusion of age in the ANOVA analysis, a t-test was conducted to compare 'unsafe crossing' behaviour scores for 11- and 12-year-olds. There was no significant difference between the 11 year old (M =1.89, *SD* = 0.65) and 12 year olds (*M* = 1.87, *SD* = .5.64); *t*(1098) = .45, *p* = .65, two-tailed). The magnitude of mean difference (.03, 95% CI [.09, .14]) was very small (eta squared = .04). Therefore, age was excluded from the analysis.

The result of the Levenes test indicated the variance between the groups were not equal, *F* (9,1090) = 4.98, *p* < .001. Therefore, the more stringent alpha of .01 was set to interpret any main effects or interactions. Higher mean scores represent more dangerous play on the road.

There was no main effect for gender, *F* (1,1090) = 0.02, *p* = .88. There was a significant main effect of prior road safety education, *F* (1,1090) = 23.43, *p* < .001, η_p^2= .02 indicating a small effect size. Those who had prior road safety education (*M* = 1.89, *SD* = .64) reported more dangerous play on the road than those who did not have prior education (*M* = 1.86, *SD*

= .64). There was a significant main effect of school location, F (2,1090) = 57.43, p <.001, η_p^2= .10 indicating a large effect size. Post hoc analysis with Tukey HSD demonstrated that children in rural schools (M = 1.66, SD = .52) reported significantly less dangerous play on the road than in small urban (M = 1.99, SD = .68) or Large urban (M = 2.06, SD = .68) schools. There was no significant difference in dangerous play on the road between those in small or large urban schools. There were no significant interactions, see Table 4.16.

Table 4.16

ANOVA Dangerous Play on the Road

	Sum of Squares	df	*F*	*p*	η_p^2
Gender	0.01	1	0.02	0.88	0.00
Education	8.77	1	23.43	<.001	0.02
Location	42.99	2	57.43	<.001	0.10
Education * Location	0.52	1	1.38	0.24	0.00
Education * Gender	0.07	1	0.19	0.66	0.00
Location * Gender	0.16	2	0.22	0.80	0.00
Education * Location * Gender	0.27	1	0.73	0.39	0.00

Summary: The analysis of variance (ANOVA) presents a consistent theme across three ARBQ behaviours assessed. There were significant gender differences across two scales with males self-reporting more risky road crossing behaviour and less planned protective behaviour than females. There were no significant gender differences for dangerous playing on the road. Children with prior road safety education in schools reported more risky road crossing and more dangerous play but on the other hand, more planned protective behaviour. The location across the three sets of analysis consistently had the strongest impact. Children in rural schools reported less risky road crossing, less dangerous play on the road and more planned behaviour than children in either the small or large urban areas. This will need to be considered in light of the exposure to traffic. This may be impacted by two influences, how the children get to school each day and how often they are out on foot on a weekly basis. Table 4.17 demonstrates that none of the children in rural school walk to school with two thirds travelling by car and a third by bus. In comparison, the children in the small (60%) and large (51%) urban areas are more likely to walk to school. This will provide the urban school children with more experience and potentially more confidence (or false confidence) to navigate the traffic environment. There is an argument that more exposure to traffic and engaging in perceived risky crossing may lead to an increased level of skill, necessary in the absence of pedestrian crossings. Note however, younger adolescents (11- 12 years) do not have the perceptual ability to accurately assess the speed of oncoming traffic and are disproportionately involved in pedestrian collisions when compared to older adolescent age groups.

Table 4.17

Transport to School by Location of School

	Rural		Small Urban		Large Urban		Total	
	N	%	N	%	N	%	N	%
Walk	0	0.00	210	60.00	145	50.70	355	32.30
Car	307	66.20	111	31.70	88	30.80	506	46.00
Bus	153	33.00	19	5.40	34	11.90	206	18.70
Cycle	4	0.90	9	2.60	15	5.20	28	2.50
Scooter	0	0.00	1	0.30	4	1.40	5	0.50
Total	464	100.00	350	100.00	286	100.00	1,100	100.00

When asked about the frequency with which they are out on the road ranging from never to everyday, it is not surprising to find that children who attend the small and large urban schools reported being out walking over 4 days to everyday more frequently than children who attend rural schools, see Table 4.18. A chi square test of independence was run on all eight cells, however, as there two cells with counts less than 5, the option 'never' was removed, and the analysis run again with all assumptions met. Children in rural areas were significantly more likely to report being out 1 to 3 days compared to the children in urban schools who were more likely to report being out 4-6 days or every day, $\chi2$ (6) = 58.48, $p < .001$, Cramer's V = .164. Increased exposure may be linked to increased risk taking due to habituation with the traffic.

Table 4.18

Frequency of Being out on Foot by Location of School

	Rural		Small		Large		Total	
	N	%	N	%	N	%	N	%
Never	8	1.70	2	0.60	2	0.70	12	1.10
<Once a week	56	12.10	22	6.30	9	3.10	87	7.90
1-3 Days	145	31.30	85	24.30	52	18.20	282	25.60
4-6 Days	128	27.60	102	29.10	78	27.30	308	28.00
Everyday	127	27.40	139	39.70	145	50.70	411	37.40
Total	464	100.0	350	100.0	286	100.00	1,100	100.00

There is also support for the finding of significantly more dangerous crossing and more dangerous play on the road reported by children who attend small and large urban schools compared to rural schools. Forty one percent of the children in rural schools reported never having a 'near-miss' compared to only 12% in small and 11% in large urban schools, Table 4.19. There is also a large discrepancy in the percentages of those children in rural schools (13%) who rated 'sometimes' having a near miss than those in small (39%) and urban (59%) schools. A chi square test of independence was run on all eight cells, however, as three cells had counts less than 5, the option 'very often' was removed, and the analysis run again with all assumptions met. Children in rural schools were significantly more likely to report never or hardly ever having a near miss compared to the children in urban schools who were more likely to report sometimes and fairly often, $\chi2$ (6) = 266.64, $p < .001$, Cramer's V = .348. Those in large urban school were significantly more likely than those in small urban schools to report sometimes and fairly often having a near miss. As the majority of children who attended urban schools also lived in the urban area, it has been suggested that living somewhere where there is a high volume of traffic might encourage a low perception of risk for on-road situations (Elliott & Baughan, 2004).

Table 4.19

Self-reported 'Near-Miss' Experiences by Location of School

	Rural		Small Urban		Large Urban		Total	
	N	%	N	%	N	%	N	%
Never	191	41.20	43	12.30	33	11.50	267	24.30
Hardly ever	208	44.80	158	45.10	60	21.00	426	38.70
Sometimes	59	12.70	135	38.60	170	59.40	364	33.10
Fairly Often	6	1.30	13	3.70	22	7.70	41	3.70
Very Often	0	0.00	1	0.30	1	0.30	2	0.20
Total	464	100.00	350	100.00	286	100.00	,	100.00

Table 4.20 sets out the summary of ANOVA results.

Table 4.20

Summary of ANOVA analysis, means and SD for three ARBQ Scales

	Mean	*SD*	*Sum of Squares*	*df*	*F*	*p*
Unsafe crossing						
Gender			2.85	1	9.66	0.002
Male	2.21	0.56				
Female	2.08	0.56				
Education			7.48	1	25.38	<.001
No	2.11	0.56				
Yes	2.19	0.56				
Location			17.70	2	30.04	<.001
Rural	2.04	0.53				
Small Urban	2.21	0.57				
Large Urban	2.24	0.57				
Planned Protective						
Gender			9.94	1	12.86	<.001
Male	2.66	0.90				

	Mean	SD	Sum of Squares	df	F	p
Female	2.91	1.00				
Education			7.55	1	9.77	0.002
No	2.70	0.94				
Yes	2.88	0.98				
Location			114.99	2	74.43	<.001
Rural	3.15	0.99				
Small Urban	2.45	0.82				
Large Urban	2.57	0.85				
Dangerous Play						
Gender			0.01	1	0.02	0.88
Male	1.87	0.63				
Female	1.87	0.66				
Education			8.77	1	23.43	<.001
No	1.86	0.64				
Yes	1.89	0.64				
Location			42.99	2	57.43	<.001
Rural	1.66	0.52				
Small Urban	1.99	0.68				
Large Urban	2.06	0.68				

* Higher means in unsafe crossing and dangerous play indicate more risky behaviour. Higher means in planned protective behaviour indicate more protective behaviour.

Section 4.3.3 Discussion on ANOVA Analysis

Age and Gender Differences: Overall, there was an apparent trend that is supported by previous literature which indicates a gender difference in relation to more risk taking in males than females. Males were significantly more likely than females to engage in more unsafe crossing, and less planned protective behaviour. Previous research has explored differences between both genders in risky behaviours and danger appraisal during childhood and found no matter how old they are, males tended to have more risky attitudes, to be less afraid of danger, more confident of their own ability to cope with danger and have greater comparative optimism facing accident risks than females (DeJoy, 1992; Harré et al., 2000; Peterson et al., 1997; Rosenbloom & Wolf, 2002). There are also observed gender differences stretching from childhood (Granie, 2007) to adulthood (Moyano Diaz, 2002; Parker et al.,1992) which demonstrate that females are more compliant with road safety rules than males, commit less violations while males expect fewer negative outcomes. Further, Morrongiello and Dawber (2004) indicated that girls complied much more than boys with maternal requests to avoid approaching a dangerous object and the perception of parental norms about risk-taking were considered much more by girls than boys. According to social psychological theory, girls are socialised to be wary of risks whereas boys are socialised to be undaunted by potential risks (Harris & Miller, 2000). They may be evidenced by the greater likelihood of parents accompanying female children to school than males (Zeedyk & Kelly 2003). This in part may explain why these young females, in particular, demonstrated more planned protective behaviour than males. It may be as a result of compliance to parental requests and concerns, the significantly less time on the roads unaccompanied by adults than the males observed in this study and less propensity for risk taking.

Interestingly, while there was more unsafe crossing reported by males, there was no gender difference for dangerous play. The items that contribute to dangerous play in this sample related more to socialising around the roads and the resultant distraction associated with that, rather than high risk actives such as playing chicken or running across the road for a dare as in other studies with older adolescents included. It was interesting to note that while males were significantly more likely to be out on the roads on their own and less likely to be out with adults, there was no significant difference in the amount of time both males and females were out around the road with friends. Therefore, this type of dangerous play and the same amount of time both genders are socialising around the roads with their friends may have resulted in this finding.

Research on the behaviour of child pedestrians at different ages (5 to 16 years) using the adolescent road users' questionnaire (ARBQ; Elliott & Baughan, 2004) indicated that in general, the 11 to 12 year age group was the safest when compared to the older demographic studied (Elliott & Baughan, 2004; Sullman et al., 2012; Wang et al. 2019). They reported less unsafe crossing, less dangerous play (apart from Belgium, Sullman et al., 2012) and more planned protective behaviour. However, only the Chinese study included children under 11 years and their study found the 11 to 12-year-olds performed significantly more unsafe crossing than the 10-year-olds. Importantly, across of the studies that examined age as a factor (10 to 19 years) unsafe road crossing behaviours increased with age across the UK (Elliott & Baughan, 2004), Spanish (Sullman et al., 2011), Belgium (Sullman et al., 2012), Iranian (Nabipour et al., 2015) and Chinese studies (Wang et al. 2019). Dangerous play on the road increased with age in the UK, Belgium and Chinese studies, but decreased with age in the Spanish research. Planned protective behaviour was higher in the younger age groups in the UK, Spanish, Iranian and Chinese research but lower in Belgium and New Zealand (Sullman & Mann, 2009).

The high level of unsafe crossing and dangerous play observed is consistent in the literature e.g., Gitelman (2019), observed 2,930 children's behaviour at three types of crossings (signalized, un-signalized and with divided roads) and suggested that children in the 11- to 12-year-old age category are beginning to demonstrate more risky behaviour, that will continue into later adolescence. Unfortunately, developmentally, they will be less likely to be able to cross complex traffic situations safely compared to those children who are over 14 years of age (O'Neal et al., 2018). There were observed gender differences in the risk taking observed between males and females. Holm et al.'s (2018) study on children with a mean age of 12.77 found that compared to girls, boys take significantly more risks as pedestrians as they often cross the road against the red light and rarely used reflectors during periods of darkness. Further, Barton and Schwebel (2007) confirmed that girls waited longer than boys and attended to traffic more than boys, who missed fewer opportunities to cross than girls and engaged in more anticipations than girls. Fu and Zu (2016) found that primary school boys were more likely to run across a pedestrian crossing than females but no other gender differences with implications for safety. Similarly, Simeunovic et al. (2021) measured the speed of children and found an impact of gender for ages 10 to 12; male children were faster than females in two regimes: "fast" and "rush", increasing to three regimes: "fast" "run," and "rush" when 12 to 15-year-olds were tested. This demonstrates an increase in speed as males get older which may significantly impact observation but leaves more openness to errors. Interestingly, Papadimitriou (2013) studied patterns of pedestrian attitudes, perceptions and behaviour in Europe across 19 European countries involving 4290 pedestrians and found that male and young pedestrians are over-represented in 'negative behaviour and negative attitudes'. Therefore, this behaviour would appear to persist from at least 10 years of age.

Unlike the development of cognitive-perceptual skill, which progressively develops as children grow older, sensation seeking is linked to pubertal maturation and follows a curvilinear pattern. Zuckerman and Kuhlman (2000), describe sensation seeking tendencies as a desire for and action toward varied, novel, exciting, complex, and intense experiences and feelings. It is suggested that these sensation seeking tendencies typically remain 'fairly flat' in early childhood but increase between age 10 and 15 before declining or remaining stable through late adolescence and early adulthood (Steinberg et al., 2008). In support of this, Sullman et al. (2012) found that those with lower levels of thrill-seeking behaviour were less likely to engage in unsafe crossing and dangerous play on the road, but also less inclined to engage in planned protective behaviour. Further, those with low behavioural inhibition were less likely to engage in planned protective behaviour and more likely to play on the road and demonstrate unsafe crossing behaviours. Therefore, as these children were in the age where sensation seeking tendencies are increasing, the level of unsafe crossing, dangerous play and lower planned protective behaviour may have been expected.

Location: The location across the three sets of analysis consistently had the strongest impact. Children in rural schools reported less risky road crossing, less dangerous play on the road and more planned protective behaviour than children in either the small or large urban areas. This should be considered in light of their exposure to traffic. None of the children in rural schools walked there with two thirds travelling by car and a third by bus. In comparison, the children in the small (60%) and large (51%) urban areas are more likely to walk to school. This will provide the urban school children with more experience and potentially more confidence (or false confidence) to navigate the traffic environment. As cognitive learning theory suggests (Bandura,1986), individuals learn behaviours by observing others and behavioural imitation is more likely when there are no negative outcomes or if there are positive outcomes for the behaviour. Therefore, children who do not experience negative consequences would be desensitised to expectations of future risk, therefore, if children are out around the roads more often and observe peers crossing streets in a risky manner and making it across safely, then they are more likely to imitate that behaviour. They may also be susceptible to unrealistic optimism (Weinstein, 1980) where self- serving biases about event-related skills, can cause people to believe that they possess the necessary skills to successfully avoid risky situations.

On the other hand, there is an argument that more exposure to traffic and engaging in perceived risky crossing may lead to an increased level of skill, necessary in the absence of pedestrian crossings. Much of the research on child pedestrian safety discusses the importance of exposure to traffic and acquiring skills in real-traffic environments (Zeedyk & Kelly, 2003), particularly developing an awareness of traffic and learning fundamental road safety practices, initially under adult supervision and leading to independent travel. Oakley (2007) found that exposure to traffic, particularly the amount of independent travel is associated with road-crossing skill. Children who walked independently more frequently were less likely to make incorrect crossing decisions compared with children who walked independently less frequently. In this study, males were out alone significantly more often than females, and it could be interpretated that while they were reporting higher levels of unsafe crossing, they were learning through experience to enter the gap faster and avoid negative consequences. However, when examining the frequency with which they reported having to run across the road or turn back to avoid being hit, combined with the high rate of near misses it suggests otherwise. For example, 41% of the children in rural schools reported never having a 'near miss' compared to only 12% in small and 11% in large urban schools.

Overall, children in rural schools were significantly more likely to report never or hardly ever having a near miss compared to the children in urban schools who were more likely to report sometimes and fairly often. It was even more marked for children in large urban areas as they were significantly more likely than those in small urban schools to report sometimes and fairly often having a near miss. As the majority of children who attended urban schools also lived in the urban area, it has been suggested that living somewhere where there is a high -volume of traffic might encourage a low perception of risk for on-road situations (Elliott & Baughan, 2004). Therefore, combined with this lower perception of risk due to the high volume of traffic and the greater frequency of being out around the roads on their own, it is likely due to their age, their level of exposure to traffic in the urban locations has increased their level of unsafe crossing and dangerous play. While they are experiencing a higher volume of near misses than expected, they may be demonstrating cognitive dissonance which occurs when a person believes in thoughts but performs actions or consumes new information that conflicts with his or her attitudes, beliefs or behaviours. Morrongiello and Matheis (2004) reasoned that dissonance-reducing goals could also be achieved by finding ways to convince oneself that the benefits of engaging in the behaviour outweigh the costs. Therefore, perhaps these children in urban areas, in particular males (as males performed more unsafe crossing than females and the interaction was just outside the required alpha level (p = .06), perceive the benefit of this unsafe crossing practice (e.g., excitement or sensation seeking), greater than the costs (i.e., possible injury).

The significant impact of females demonstrating more planned protective behaviour in rural schools rather than in urban schools is a surprising finding. This may be again, driven by the higher proportion of females in rural schools (58%) compared to males (42%). Further, the level of accompaniment by adults in the female population was significantly higher than for males. This may indicate there were more females in the rural population, with higher levels of accompaniment, providing more opportunity for planned protective behaviour to be reported than for males.

Education: Children with prior road safety education in schools reported more risky road crossing and more dangerous play but on the other hand, more planned protective behaviour. This is an interesting finding and one that is easier to explain for the observed higher level of planned protective behaviour. The RSA programmes that these primary school children have been exposed to concentrate more on planned protective behaviour, than on how to cross a road safely. Starting with the Seatbelt Sherriff, this is an educational programme provided to the schools for teachers to deliver and encourage them to enter a poster competition. Children are asked to always wear their seatbelt and to encourage others in their family to also wear a seatbelt. Hi Glo Silver, is another school-based programme where the school provides the education around the caption 'be safe, be seen'. These packs come with promotional posters which can be observed on the walls in classrooms and hallways that provided this programme. The schools are also asked on request to provide materials such as high vis vests, pencils, mini bicycle light, keychains and other leaflets that will reinforce the message of high visibility and seatbelt use. Therefore, the children who responded to the questions on planned protective behaviour may have been primmed for the correct answer whether or not they are practicing the required behaviour. This would be supported by the lower level of uptake of hi-vis vets in this sample. While there may be an impact of this education, it can't be determined from this study alone, but it does suggest that there is a higher level of reporting of planned protective behaviour in schools who provide road safety programmes. The RSA also deliver materials and videos related to the Safe Cross Code and run a competition for the best safe cross code dance by a primary school. However, the uptake of this is lower due to the higher time commitment required and so less than 10% of the schools in this sample had run this competition. There is also some difficulty with the tabletop instruction for the safe cross code. While children of a younger age will not understand what is actually being asked of them when asked to look all around or both ways before crossing (Tolmie et al., 1998), there has also been considerable evidence in the literature that the use of printed materials or visual aids such as film and video have limited effectiveness unless accompanied by behavioural training in real environments (Dragutinovic & Twisk, 2006; Raftery & Wundersitz, 2011). The 'StreetSmart' programme is an interactive programme where a model street scene is delivered to the school hall and children are asked to participate in road crossing and observe the consequences of poor visibility and stopping time. In this sample, it was a pre-requisite that all schools in the education group had participated in the StreetSmart programme and all children were asked if they had been in attendance on the day of delivery. The main issue again, is that this is a once off event which lasts for approximately an hour for each class. There is also a substantial amount of time spent delivering verbal messages and video content, leaving less time for the fully interactive component. It does clearly impart the message again of , 'be safe, be seen', 'buckle up', and importantly for this age group to always use a pedestrian crossing when one is nearby and to always wait to cross at a pedestrian crossing (even with green pedestrian light) until all cars have stopped. While it may be a behavioural intervention, it is limited by the lack of realism and therefore can't compete with behavioural programmes run either in VR or on roadside locations. While a full critique and review of the effectiveness of road safety education programmes in primary school is outside the remit of this study, published reviews on their effectiveness suggest that where there are published evaluations, the effects at best are small but that the best outcomes are from those that have a strong behavioural component.

The children in this sample reported more unsafe crossing in schools where this programme and other RSA programmes had been run. It is difficult to explain this finding within these results. The interaction between location and education was significant at the

.02 level, however, due to the violation of homogeneity of variance a stricter alpha of .01 was set. As it is a challenge to explain this finding in this analysis, these variables have been inputted into a regression model which combines other demographic and attitudinal variables to assess potential moderators in the next section.

Section 4.3.4 Demographic Comparison with Previous ARBQ Studies

For the purpose of this comparison, six studies with demographic analysis on the ARBQ behaviours have been reviewed. It should be noted that the age of publication of these studies range from 2004 to 2019. This may have an impact on some behaviours, such as the increased use of mobile phones in the younger populations from older to newer studies. There are cultural differences to consider such as the more individualistic societies in Ireland, the UK (Elliott & Baughan, 2004), Spain (Sullman et al., 2011), Belgium (Sullman et al., 2012) and New Zealand (Sullman & Mann, 2009) compared to the more collectivist societies of Iran (Nabipour et al., 2015) and China (Wang et al. 2019). Despite these obvious limitations, there is a similarity in the behaviours across each study indicating that some factors remain stable over time and across nationalities.

It should be noted that while age was not used as a variable in this analysis, however, studies using the adolescent road users questionnaire (ARBQ; Elliott & Baughan ,2004) to assess 11 to 12 year olds along with older adolescents (Elliott & Baughan, 2004; Sullman et al., 2012; Wang et al. 2019), found this population performed the safest on the road, reporting less unsafe crossing, less dangerous play (apart from Belgium, Sullman et al., 2012) and more planned protective behaviour, however, only the Chinese study included children under 11 years and their study found the 11 to 12 year olds performed significantly more unsafe crossing than the 10 year olds. Importantly, across of the studies that examined age as a factor (10 to 19 years) unsafe road crossing behaviours increased with age across the UK (Elliott & Baughan, 2004), Spanish (Sullman et al., 2011), Belgium (Sullman et al., 2012), Iranian (Nabipour et al., 2015) and Chinese studies (Wang et al. 2019). Dangerous play on the road increased in age in the UK, Belgium and Chinese studies, but decreased with age in the Spanish research. Planned protective behaviour was higher in the younger age groups in the UK, Spanish, Iranian and Chinese research but lower in Belgium and New Zealand (Sullman & Mann, 2009).

Gender: Gender differences remained relatively stable across each study with males more likely to engage in unsafe crossing than females in Ireland, the UK, Belgium, Spain and China. There were no gender differences in unsafe crossing in New Zealand or Iran. Planned protective behaviour was higher in females in Ireland similar to the UK and Chinese studies, but different to Iran where males reported more planned protective behaviour. No gender differences were reported in Belgium, Spain, New Zealand. For dangerous play on the road, the Irish sample found no gender differences which was in contrast to males performing this behaviour more often in the UK, Spain, Belgium, New Zealand, Iran and China. However, this needs to be interpreted with caution as the items in the Irish 'dangerous play' scale were comprised of less 'high risk' items included in the other studies such as playing chicken by lying on the road or running at the traffic and holding onto moving vehicles while on bikes and scooters. The dangerous play items in the Irish scale were related to socialising on the road rather than extreme risk behaviours. These higher risk items are more likely to occur in older adolescents as discussed in Section 1.3 in the introduction.

School Location: The behaviour in rural versus small and large urban locations was not collected in all studies (Spain). Where it was assessed, Belgium and New Zealand reported non-significant differences due to school location across all three behaviour scales. Adolescents in Iran found no difference in behaviour by school location for unsafe crossing whereas those in the Chinese study reported adolescents in rural areas performed more unsafe crossing than those in large urban areas. In contrast to this, Ireland, similar to the UK, children in rural areas were less likely to engage in unsafe crossing than those in large urban areas. Unlike the UK, Ireland also reported that those in rural schools were also significantly less like to perform unsafe crossing behaviours than those in small urban area. There was no difference depending on whether the school was in a large versus small urban area. Planned protective behaviour was also different across the studies. In the Iranian and Chinese samples, those in large urban areas were more likely to engage in planned protective behaviour than those in small urban or rural areas. In contrast both the UK and Ireland found overall, those in rural areas were more likely to engage in planned protective behaviour than those in an urban setting, with no difference whether in a small or large urban area. The UK had a significant interaction with age and the school location with younger children aged 11 to 12 years behaving more safely in rural, small urban and large urban areas than their older counterparts. In Ireland, the planned protective behaviour needs to be interpreted in light of the significant interaction with gender where females who attended rural and small urban schools reported significantly more planned protective behaviour than males but significantly less than males when attending large urban schools. Males who attended small urban schools reported significantly less planned protective behaviour than those who attended a large urban school. By contrast, females who attended small urban schools reported significantly more planned protective behaviour than when attending a large urban school. Dangerous play on the road was also different across the various studies. In Iran, China and the UK, there was more dangerous playing on the road reported in rural compared to large and small urban areas. By contrast, in Ireland, children in rural schools were less likely to report dangerous play compared to those in small and large urban areas.

Overall, the Irish data lends further support to the findings in the other countries using the ARBQ data to assess behaviour in young adolescents, most particularly in the gender differences in unsafe crossing and planned protective behaviour with males taking more risks and engaging in less planned protective behaviour than females.

Section 4.4 Predictors of Road Use Behaviour in 11- to 12-year-olds Ireland

This section examines the impact of several independent variables identified in Section 2.1.4 on the outcome behaviours identified; 'Unsafe Crossing', 'Planned Protective Behaviour' and 'Dangerous Play on the Road' in Chapter 3.

Section 4.4.1 Investigation of the Predictor Variables

How each of the independent predictors identified in Section 2.1.4 are structured for analysis and inclusion in the HLM modelling are set out below:

1. Gender - male and female.
2. School location was collapsed from three levels to two levels to rural and urban due to previous ANOVA analysis indicating that there was no significant difference in behaviour between small or large urban area across all three behaviours. This provides a more simplified level of school location but still retains the key properties of the variable.
3. Near miss- collapsed into a binary variable to reflect having never had a near miss to having had a near miss.

4. Previous road safety education in school, yes or no, provided by the RSA
5. Exposure items – a composite score was created by summing the responses from the question on frequency of going out 'on foot', 'on a bike' and 'on a scooter, skateboard, skates'. Higher scores indicate more exposure.
6. Accompaniment – A set of three continuous variables reflect the frequency of accompaniment by friends or adults when out or how often they are out and about on their own. Higher scores in each variable indicate more exposure.
7. Responsibility beliefs and deflecting responsibility beliefs (Section 4.1.3). A composite score for each scale was created. Higher scores in 'responsibility beliefs' indicate greater level of personal responsibility while on the road. Higher score in 'deflected beliefs' indicate less positive attitudes towards personal responsibility.

Prior to running the HLM modelling a series of analysis were run to first assess the factor structure of the road safety responsibility beliefs and to examine the impact of gender on responsibility beliefs, exposure to traffic and the level of accompaniment while out around the roads. Where relevant, the direction of scores on composite variables are identified to aid interpretation.

Section 4.4.1.1 Responsibility Beliefs

These items were described in section 4.1.3 and are designed to measure a respondent's beliefs about how risky or safe they perceived their behaviour to be and assessed their belief about who should be responsible for their safety while on the road. Examination of the KMO (0 .72) and Bartletts Test of Sphericity (p < .001) indicate the data is suitable for factor analysis.

The seven questions on beliefs were subjected to a principal axis factor analysis with varimax rotation. The data were best fitted by a two-factor solution accounting for 44.1% of the variance (Figure 4.5, Table 4.21). Factor 1 accounted for 27.9% of the variance and included items concerned with taking responsibility for their own safety and acting responsibly. Factor 2 accounted for 16.3% of the variance. The two items on this factor deflected responsibility for their own behaviour.

Figure 4.5

Scree Plot Responsibility Beliefs

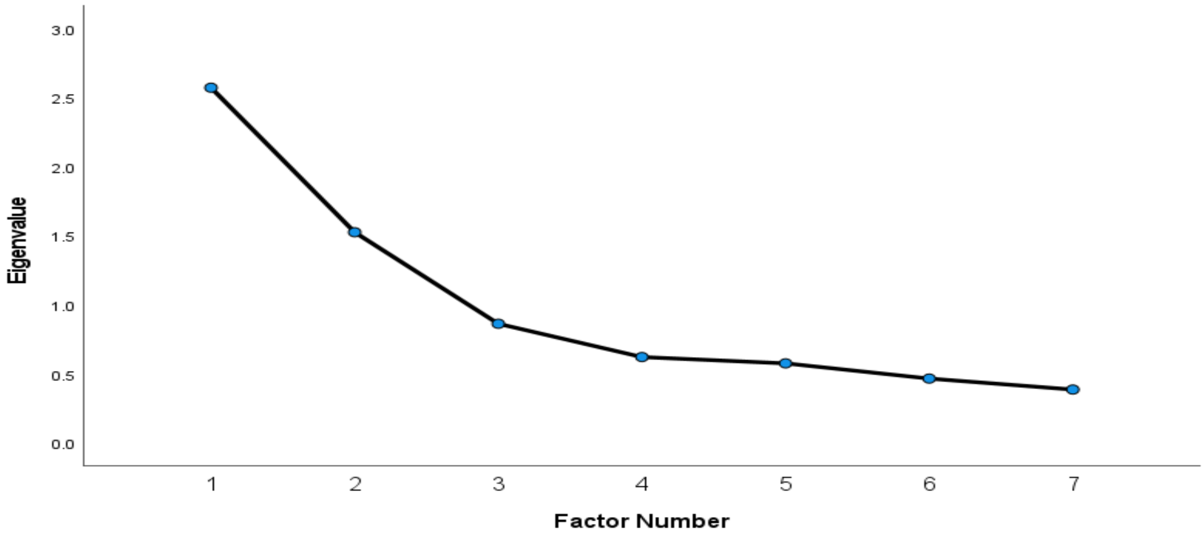


Table 4.21

Factor Loadings Responsibility Beliefs

Item	*Factor 1*	*Factor 2*
I do things that are risky when out around roads	**-0.58**	0.10
I generally pay a lot of attention to traffic when out around roads	**0.71**	0.00
In general, I act responsibly when out around roads	**0.71**	0.01
I am aware of the dangers around the roads	**0.60**	-0.10
I should be responsible for my safety when I am out around roads	**0.50**	-0.13
Drivers should be responsible for my safety when I am out around roads	-0.06	**0.67**
Other people should be responsible for my safety when I am out around roads	-0.11	**0.86**

The five items on Factor 1 were summed to produce a composite scale titled 'Responsibility Beliefs'. As one item negatively loaded onto this factor 'I do things that are risky when I am out on the roads' (Table 4.21) it was reversed coded so that higher scores on all items represented a stronger attitude of personal responsibility. This scale had a Cronbach Alpha of 0.75.

The 2 items on Factor 2 were summed to produce a composite scale called 'Deflected Responsibility Beliefs' with a Cronbach Alpha of .73. Higher scores on this scale indicated less desirable road safety beliefs. The reliability remains very similar to that of the original research with reliability of .76 (Factor 1) and .74 (Factor 2). Table 4.22 sets out the means and SDs of these two scales.

Like in the original research, 'I should be responsible for my safety when I am out around roads' and 'other people should be responsible for my safety when I am out around roads' did not load onto the same factor. According to Elliott and Baughan (2004), this may be because adolescent road users may believe that both they and others, like motorists, have a role to play in their safety while on the road.

Table 4.22

*Descriptives for Responsibility Beliefs and Deflected Responsibility Beliefs Scale*s

	Min	*Max*	*M*	*SD*	*Skew*	*Kurt*
Deflection Beliefs	2	10	5.05	2.12	0.47	-0.35
Responsibility Beliefs	5	25	21.1	3.02	-1.25	2.99

As can be seen in Table 4.22, there was a very high mean score for responsibility beliefs with a corresponding low mean for deflecting beliefs. To further support the perception of themselves as not 'doing things that are risky when out around roads' a chi square analysis found a significant association between their self-reported near-miss experiences and their rating for behaving in a risky manner while on the roads, $\chi 2$ (8) = 108.2, $p < .001$, Cramer's V = .226. Children who strongly disagreed to acting in a risky manner were more likely to report never or hardly ever having a near-miss while on the road (Table 4.23). Due to a number of cells having less an expected count less than 5, the categories fairly often and very often were removed.

Normality of Scales: As set out in Table 4.22, there was evidence of skew and kurtosis in both scales, however, as cited previously when assessing the normality of the composite scale data, Hair et al. (2010) and Bryne (2010) argued that data is considered normal if skewness is between -2 to +2 and kurtosis is between -7 to +7. The KS test for both scales indicated non normal data, responsibility beliefs D (1098) = 0.11, $p < .001$ and deflected beliefs, D(1098) = 1.3, $p < .001$. However, as the sample size is large and it is expected to have some level of skew in Likert data, these data will be treated as parametric for the HLM.

Table 4.23

Act Risky on Road by Near Miss

	Strongly Agree		Agree		Not Sure		Disagree		Strongly Disagree		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Never	6	15.00	8	6.80	23	13.60	73	19.50	157	39.30	267	24.30
Hardly ever	9	22.50	40	33.90	65	38.50	156	41.70	156	39.10	426	38.70
Sometimes	16	40.00	61	51.70	72	42.60	136	36.40	79	19.80	364	33.10
Fairly Often	7	17.50	9	7.60	9	5.30	9	2.40	7	1.80	41	3.70
Very Often	2	5.00	0	0.00	0	0.00	0	0.00	0	0.00	2	0.20
Total	40	100.0	118	100.0	169	100.0	374	100.0	399	100.00	110	100.0

Gender differences: To assess any differences between genders on responsibility beliefs, to alert to the possible interaction effect in subsequent modelling, a *t*-test was run. Prior to running this test, a test of the assumptions underlying parametric analysis was conducted. The KS test was significant for males, $D(581) = .12$, $p < .001$ and females $D(517) = .12$ $p < .001$). A visual inspection indicated some skewness and kurtosis (4.24), however, it was deemed to fall within the acceptable range. Further, the Levenes test indicated homogeneity of variance, F (1, 1096) = 2.12, $p = .15$. Therefore, the data were considered suitable for parametric analysis.

The *t*-test indicated a significant difference in genders on responsibility beliefs with females (M = 21.47, SD = 2.86) scoring higher than males (M = 20.96, SD = 3.15); t (1098), p =.005, two tailed. The magnitude of the difference (mean difference = -.51, 95% CI [-.87, -.15]) was small, (Cohens d = -.12).

To assess any differences between genders on deflected beliefs, a Mann-Whitney U was run. Prior to running this test, a test of the assumptions underlying parametric analysis was conducted. The KS test was significant for males, D (581) = .13, $p < .001$ and females $D(517) = .13$ $p < .001$). The data approximated a normal distribution from a visual inspection. However, the Levenes test indicated a violation of homogeneity of variance, F (1, 1096) = 2.50, $p < .001$. Therefore, the data were not considered suitable for parametric analysis.

The Mann-Whitney U indicated a significant difference in genders on deflected beliefs with males (*Md* = 5, *n* = 581) scoring higher than females (*Md* = 5, *n* = 517); *U* = 132407.500, *z* = -3.43, *p* < .001, *r* = .10 indicating a very small effect size.

Therefore, for both scales, females demonstrated higher responsibility beliefs and lower deflected beliefs than males, however, the effects were very small.

Section 4.4.1.2 Exposure

The exposure composite score was created by summing the responses from the question on frequency of going out 'on foot', 'on a bike' and 'on a scooter, skateboard, skates'. Higher scores indicate more exposure. According to the literature, to treat ordinal data as a continuous, as per Section 4.2, the summative score of a respondent provides a realistic distance from the summative score of a different respondent, thereby it can be labelled as interval estimates (Carifio & Perla, 2008; Boone & Boone, 2012). As this data is to be inserted into the HLM as a centred within cluster (CWC) variable it was based on the original summed score and not based on the composite mean.

Normality: There was no evidence of skewness (.60) or kurtosis (.30) with both falling within the lowest range of +1/-1. While the KS test was significant, *D* (1,100) = .94, *p* < .001, the visual inspection, combined with an examination of outliers and histogram indicated that it approximated the normal distribution.

Gender differences: To assess any differences between genders on exposure, a *t*-test was run. Prior to running this test, a test of the assumptions underlying parametric analysis was conducted. The KS test was significant for males, *D* (583) = .62, *p* < .001 and females *D*(517) = .18 *p* < .001), not unusual for large samples. A visual inspection indicated no skewness and kurtosis with both falling within the lowest range of +1/-1 (Table 4.24). Further, the Levenes test indicated homogeneity of variance, *F* (1, 1098) = 2.69, *p* = .10. Therefore, the data were considered suitable for parametric analysis.

The *t*-test indicated a non-significant difference on exposure between males (*M* = 8.00, *SD* = 1.89) and females (*M* = 7.94, *SD* = 1.78); *t* (1098), *p* =.52, two tailed.

Urban/rural school location: As exposure to traffic may be different depending on the location of the school it was important to assess any differences to assist further interpretation of the data. Prior to running this test, a test of the assumptions underlying parametric analysis was conducted. The KS test was significant for rural, *D* (464) = .15, *p* < .001) and urban *D* (636) = .18 *p* < .001) locations. There was no evidence of skewness in rural (.58) or urban (.59) schools and no evidence of kurtosis in rural (.49) and urban (.13) schools. Further, the Levenes test indicated homogeneity of variance, *F* (1, 1098) = 3.81, *p* = .07. Therefore, the data were considered suitable for parametric analysis.

The *t*-test indicated a significant difference on exposure between rural (*M* = 7.54, *SD* = 1.69) and urban (*M* = 8.29, *SD* = 1.86); *t* (1098), *p* < .001, two tailed. The magnitude of the difference (mean difference = -.75, 95% CI [-.97, -.54]) was approaching a medium effect, (Cohend d = -.42). Therefore, the higher exposure in the urban school population compared to the rural school population will need to be considered.

Section 4.4.1.3 Accompanied by Friends, Adults or on Own

A set of three continuous variables reflect the frequency of accompaniment by friends or adults when out or how often they are out and about on their own. Higher scores in each variable indicate more exposure (everyday). All questions were rated on a 5-point Likert scale ranging from 'Never' to 'everyday'. There is a differing of opinions in the literature as to how to handle Likert data in a linear regression model, however, many have stated that ordinal variables with five or more categories can often be used as continuous without any harm to the analysis you plan to use them in (Norman, 2010; Sullivan & Artino, 2013). In cases like this, researchers usually refer to the variable as an "ordinal approximation of a continuous variable,". Research also suggests it is acceptable once the distributions approximate normality. An assessment of the normality of this data indicated that each variables distribution approximated the normal distribution and there are five categories on the scale. Further, these variables will be transformed by centring within cluster as Level 1 predictors providing more statistical precision.

Normality: For 'out and around the roads on your own' the KS was significant, *D* (1,100) = .19, *p* < .001. However, there was no evidence of significant skew (.27) or kurtosis (-1.05) and outliers were not having an impact. For accompanied by adult, the KS was significant, *D* (1,100) = .21, *p* < .001. However, there was no evidence of significant skew (.32) or kurtosis (-.41) and outliers were not having an impact. For accompanied by adult, the KS was significant, *D*(1,100) = .21, *p* < .001. However, there was no evidence of significant skew (.13), or kurtosis (-.97) and outliers were not having an impact (Table 4.24).

Gender differences: As the aim is to assess the difference in each variable by gender the decision was made to use Mann-Whitney based on the median as we are directly comparing two sets of Likert responses.

The Mann-Whitney U indicated a significant difference in genders frequency of being out around the roads on their own. Males (*Md* = 5, *n* = 581) were out on the roads on their own significantly more often than females (*Md* = 5, *n* = 517); *U* = 132407.500, *z* = -4.38, p < .001, *r* = -.13 indicating a small effect size.

The Mann-Whitney U indicated a significant difference in genders on frequency of being accompanied by an adult. Males (*Md* = 3, *n* = 581) were out significantly less often than females (*Md* = 2, *n* = 517) in the company of adults; *U* = 173582.0, *z* = 4.55, *p* < .001, r = .14 indicating a small effect size.

The Mann-Whitney U indicated no significant difference in genders on frequency of being out around the roads with friends; Males (*Md* = 5, *n* = 581) and females (*Md* = 5, *n* = 517); *U* = 148244.0, *z* = .481, *p* = 630.

Overall, males were more likely to be out around the roads on their own, while females were more likely to be out accompanied by adults. There was no difference in the frequency of being out accompanied by friends. Table 4.24 sets out the descriptives on the raw scores for each predictor variable by gender.

Table 4.24

Descriptives for Level 1 Predictors ARBQ by Gender

Predictor	**Male**						**Female**					
	M	*SD*	*Skew*	*Kurt*	*Min*	*Max*	*M*	*SD*	*Skew*	*Kurt*	*Min*	*Max*
Exposure	8.00	1.89	0.53	0.10	4	14	7.94	1.78	0.71	0.59	4	13
Responsibility Beliefs	20.96	3.15	-1.23	2.69	5	25	21.47	2.86	-1.25	3.16	5	25
Deflected Beliefs	5.26	2.21	0.34	-0.64	2	10	4.81	1.99	0.62	0.15	2	10

Accompany Own	2.94	1.29	0.07	-1.05	1	5	2.62	1.32	0.51	-0.88	1	5
Accompany Adults	2.73	1.02	0.35	-0.28	1	5	3.03	1.08	0.26	-0.54	1	5
Accompany Friends	2.95	1.26	0.09	-1.08	1	5	2.91	1.16	0.18	-0.82	1	5

Section 4.4.2 HLM Analysis on 'Unsafe Crossing'

Building HLM models generally begins with a null, or empty model after which predictors are then added to the model in a forward or backward elimination approach. The overall fit of each model is assessed throughout the model building process outlined in Section 2.3. Table 4.25 sets out each of the independent variables and their data format.

Table 4.25

Predictor Variables Levels and Coding

Variable	Measurement	Levels	Coding
Gender	Categorical	Two	• Male = 0 • Female = 1
School Location	Categorical	Two	• Rural = 0 • Urban = 1
RSA Education	Categorical	Two	• No = 0 • Yes = 1
Near Miss	Categorical	Two	• No = 0 • Yes = 1
Accompanied Adult	Continuous		
Accompanied Friend	Continuous		
Accompanied No	Continuous		
Exposure	Continuous		
Responsibility Beliefs	Continuous		
Deflecting Responsibility	Continuous		

The formal alternative hypotheses for each behaviour (DV) are as follows and will be tested across models in a sequential order as per the modelling strategy outlined:

1. There will be evidence of clustering at school level in the data.
2. Gender will be a significant predictor of the DV.
3. Level of exposure to roads will be a significant predictor of the DV.
4. Frequency of being out on the roads accompanied by friends will be a significant predictor of the DV.
5. Frequency of being out on the roads on their own will be a significant predictor of the DV.
6. Frequency of being out on the roads accompanied by adults will be a significant predictor of the DV.
7. Location of the school (urban or rural) will be a significant predictor of the DV when controlling for demographic variables.
8. Presence of RSA road safety education in schools will be a significant predictor of the DV when controlling for demographic variables.
9. Previous experience of having a near – miss in traffic will be a significant predictor of the DV when controlling for demographic variables.
10. Responsibility beliefs will be a significant predictor of the DV when controlling for demographic variables.
11. Deflected responsibility beliefs will be a significant predictor of the DV when controlling for demographic variables.
12. There will be a significant interaction between school location and demographic, attitudinal and behaviour variables.
13. There will be a significant interaction between education and demographic, attitudinal and behaviour variables.
14. There will be a significant interaction between school location and education for the DV.
15. There will be significant interactions between gender and the remaining Level 1 predictors.
16. There will be significant interactions between near-miss and the remaining Level 1 predictors.

All for assumptions underlying HLM were satisfied prior to analysis.

Model 1: Unconditional Model (random intercept model)

Also referred to as the null model, this basic two-level model is equivalent to a one-way random effect ANOVA and is the simplest possible random effect linear model. This model is used within this HLM framework to first ascertain the degree to which variance at Level 1 depends upon group membership at Level 2, and second, to establish a baseline model from which subsequent models can be compared. Specifically, in this research, the null model asks how much schools vary in their mean unsafe crossing behaviour.

This model allows the intercepts to randomly vary between schools. As no predictors are included in the model at Level 1, the intercepts are equal to the school means for the Level 1 outcome variable (i.e., unsafe crossing). The results for the unconditional model demonstrate the mean regression coefficients for unsafe crossing varied significantly around the grand mean (β = 36.524, $P < .001$). The within group variance in unsafe crossing was 82.89 (CI: 76.13; 90.27) and the between group variance was 7.95 (CI: 4.32;14.61) both of which were significant ($p < .001$; $p = .001$) according to the Wald Z test (split p-value, Heck et al., 2014; Hox, 2010). This is the first indication of clustering.

The intraclass correlation coefficient (ICC) was computed to allow further evaluation on the level of non-independence in the outcome at Level 1. The ICC for the null model of 0.09 indicated that 9% of the variation in reported 'unsafe crossing' occurs between schools. While this may appear to be a small amount of variance Heck et al. (2014) noted that .05 is often considered a "rough cut-off" of evidence of substantial clustering while Pituch & Stevens, (2016) suggested even trivial amounts of clustering (where ICC's are <.05) can lead to increased type 1 error probability when carrying out tests of predictors in a model. Therefore, ICC and test of the variance component for the first model suggested the presence of clustering in the data which supported the use of HLM, as opposed to OLS regression, for data analysis. Therefore, we can reject the null hypothesis 1 as there was evidence of clustering.

Model 2: Fixed level 1 Predictors and Randomly Varying Intercepts

This stage of the modelling strategy introduced Level 1 demographic predictors, gender, exposure and type of accompaniment when out around on the roads. These were included in a 'block entry' approach to examine the contribution of each and to also act as a control for the further addition of the behaviour and responsibility belief variables in further models. This model will test hypotheses 2 to 6.

Analysis yielded no main effect for exposure (β = -.06, *t* (1058.173) = -.381, *p* = .70), therefore, exposure was dropped, and Model 2 was rerun. Gender was a significant negative predictor (β = - 1.84, *t*(1058.26) = -2.96, *p* = .003) of reported unsafe crossing, indicating that within their groups males tended to score higher on unsafe crossing behaviour than females. All levels of accompaniment were significant predictors, albeit in different directions. Being out around the roads more frequently on their own (β = 0.53, *t*(1058.26) = 2.44, *p* < .01) indicated that within their groups these children scored higher on unsafe crossing behaviour. Similarly, those who were out around the roads more frequently with their friends (β = 1.28, *t*(1058.26) = 5.26, *p* < .001) also demonstrated that within their groups these children scored higher on unsafe crossing behaviour. On the other hand, children who were out on the roads more frequently with adults (β = - 1.49, *t*(1058.26) = -5.72, *p* <.001) demonstrated within their groups, lower levels of unsafe crossing.

As with Model 1, both Level 1(75.99, CI: 69.78;82.7) and Level 2 (8.22, CI: 4.56; 14.8) variance estimates are statistically significant (*p* <.001). The ICC increased from .09 to .10 as when using CWC the intercepts are unadjusted for between-group differences on the predictor. Therefore, the ICC will get larger (relative to the null model) in a model including only Level 1 predictors. However, as both the Level 1 and 2 estimates were significant this indicates there is still substantial variance to be accounted for at each level. The majority of the variance in this model is at student level. A likelihood-ratio chi-squared test showed the addition of the demographic variables significantly improved the fit of the data, when compared to Model 1 ($\chi 2$ (4) = 92.18, *p* < .001, *pseudo* R^2 = .01). This model failed to reject the null hypothesis for H3 exposure, but rejected it for H2 (gender), 4, 5 and 6 (levels of accompaniment).

<u>Model 3: Fixed level 1 and Level 2 Predictors Randomly Varying Intercepts</u>

Building on from Model 2, this third model incorporated the corresponding group level demographic variable (reintroducing the mean) and introduced two new Level 2 predictors (school location and education). This model will act as a control for when the Level 1 attitudinal and behaviour variables are included and will test hypotheses 7 and 8.

As with the previous model, the demographic variables were all significant predictors at Level 1. Gender was a significant negative predictor (β = - 1.84, *t*(1058.75) = -2.96, *p* = .003) of reported unsafe crossing, indicating that within their groups males tended to score higher on unsafe crossing behaviour than females. All levels of accompaniment were significant predictors. Being out around the roads more frequently on their own (β = 0.53, *t*(1058.75) = 2.44, *p* = .02) indicated that within their groups these children scored higher on unsafe crossing behaviour. Similarly, those who were out around the roads more frequently with their friends (β = 1.28, *t*(1058.75) = 5.27, *p* < .001) also demonstrated that within their groups these children scored higher on unsafe crossing behaviour. On the other hand, children who were out on the roads more frequently with adults (β = - 1.49, *t*(1058.75) = -5.72, *p* <.001) demonstrated within their groups, lower levels of unsafe crossing. None of the demographic variables were significant predictors at Level 2 indicating that the demographic composition in this study at school level was not a significant predictor of unsafe crossing behaviour. The two new Level 2 predictors were significant. School location was a positive predictor (β = 4.28, *t*(38.09) = 2.59, *p* = .01) where children in urban schools reported more unsafe road crossing than those in rural schools. Education was also a significant positive predictor (β = 2.71, *t*(36.93) = 2.789, *p* = .008) where children in schools with previous road safety education reported more unsafe road crossing behaviour than those who did not.

As with Model 2, both Level 1(75.99, CI:69.79; 82.75) and Level 2 (3.76, CI: 1.62; 7.88) variance estimates are statistically significant (*p* <.001). The ICC decreased from .10 to .05 indicating that 5% of the variation in reported ‘unsafe crossing’ occurs between schools. The majority of the variance still remains within student level. As both variance estimates were significant, there is still more variance to be explained at both levels. A likelihood-ratio chi-squared test showed the addition of the Level 2 variables significantly improved the fit of the data, when compared to Model 2 ($\chi 2$ (6) = 22.05, *p* < .05, *pseudo* R^2 = .002) but the effect size was very small. Therefore, the null hypotheses for H7 and H8 are rejected as location and education were significant predictors of unsafe crossing.

Model 4: Two-level Model with Fixed Level 1 and Level 2 Predictors and Randomly Varying Intercepts

This model included an additional behaviour predictor (near miss) at Level 1 and Level 2 to account for the additional variance yet to be explained. This model will test hypothesis 9. Only variables that were significant predictors at either level in Model 3 were considered for this model. Initial analysis indicated that location was now not a significant predictor and was removed from model with Model 4 re-run as per the model building strategy. As with the Model 3, the demographic variables were all significant predictors at Level 1. Gender was a significant negative predictor (β = - 1.28, t(1058.78) = -2.27, p = .03) of reported unsafe crossing, indicating that within their groups males tended to score higher on unsafe crossing behaviour than females. Being out around the roads more frequently on their own was a significant predictor (β = 0.45, t(1058.78) = 2.23, p = .03) indicating that within their groups these children scored higher on unsafe crossing behaviour. Similarly, those who were out around the roads more frequently with their friends was also a significant predictor (β = .80, t(1058.78) = 3.59, p < .001) demonstrating that within their groups, these children scored higher on unsafe crossing behaviour. On the other hand, children who were out on the roads more frequently with adults were a significant negative predictor (β = -1.06, t(1058.78) = -4.50, p <.001) demonstrating within their groups, lower levels of unsafe crossing. Having a near miss was a significant positive predictor at both Level 1 (β = 9.69, t(1058.78) = 15.33, p <.001) and Level 2 (β = 12.37, t(42.5) = 6.66, p <.001). This suggests that as well as children who reported having a near miss within their group reporting higher unsafe road crossing, children who were attending schools with higher proportion of near miss experiences were more likely to report higher levels of unsafe crossing. Possible interactions will be examined in future models. Education was also a significant positive predictor (β = 1.70, t(41.48) = 2.37, p = .02) where children in schools with previous road safety education reporting more unsafe road crossing behaviour than those who did not.

As with Model 3, both Level 1(62.16, CI:57.08; 67.68) and Level 2 (2.83, CI: 1.27; 6.30) variance estimates are statistically significant (p <.001). The ICC decreased from.05 to .04 indicating that 4% of the variation in reported 'unsafe crossing' occurs between schools. As both variance estimates were significant, there is still more variance to be explained at both levels. A likelihood-ratio chi-squared test showed the addition of the near miss variables significantly improved the fit of the data, when compared to Model 3 ($\chi2$ (3) = 221.92, *p* < .001, *pseudo* R^2 = .03). While the effect size was larger for Model 4 than for Model 3, it remained small. The null hypothesis is rejected for H9 as near miss was a significant predictor.

Model 5: Two-Level Model with Fixed Level 1 and Level 2 Predictors and Randomly Varying Intercepts

This model included the final Level 1 attitudinal predictors (responsibility belief and deflected belief) to account for the additional variance yet to be explained. This model will test hypotheses 10 and 11. Only variables that were significant in Model 4 were carried forward to this model. Initial analysis indicated that deflected belief was a non-significant predictor at both Level 1 and Level 2, therefore, these variables were removed and the model re-run to produce a more parsimonious solution. Unlike the previous models, gender was a non-significant negative predictor (β = - 0.61, *t*(1056.11) = -1.23, *p* = .22) of reported unsafe crossing. All levels of accompaniment remained significant predictors. Being out around the roads more frequently on their own (β = 0.37, *t*(1056.11) = 2.2, *p* = .03) indicated that within their groups these children scored higher on unsafe crossing behaviour. Similarly, those who were out around the roads more frequently with their friends (β = .62, *t*(1056.12) = 3.27, *p* =.001) also demonstrated that within their groups children scored higher on unsafe crossing behaviour. On the other hand, children who were out on the roads more frequently with adults (β = -.57, *t*(1056.11) = -2.81, *p* =.005) demonstrated within their groups, lower levels of unsafe crossing. None of the demographic variables were significant predictors at Level 2, indicating that the demographic composition at school level was not a significant predictor of unsafe crossing behaviour. Having a near miss was a significant positive predictor at both Level 1 (β = 7.23, *t*(1056.10) = 12.90, *p* <.001) and Level 2 (β = 12.41, *t*(41.96) = 6.73, *p* <.001). This suggests that as well as children who reported having a near miss within their group reporting higher unsafe road crossing, children who were attending schools with higher proportion of near miss experiences were more likely to report higher levels of unsafe crossing. Possible interactions will be examined in future models. The new attitudinal variable, responsibility beliefs was a significant negative predictor at both Level 1 (β = -1.44, *t*(1056.11) = -19.09, *p* <.001) and Level 2 (β = -2.07, *t*(41.5) = -9.13, *p* <.001). This suggests that as well as children who reported higher responsibility beliefs within their group reporting lower levels of unsafe road crossing, children who were attending schools with a higher mean level of responsibility beliefs were more likely to report lower levels of unsafe crossing. Education was a non-significant predictor (β = .58, $t(39.23) = 1.30$, $p = .20$).

Level 1 variance was significant at $p < .001$ (46.25, CI:42.48; 50.37) however, Level 2 was non-significant ($p = .938$) indicating that there is no more variance to be explained at this level. The ICC decreased from.05 to .0007 indicating that a minimal amount of the variation in reported 'unsafe crossing' occurs between schools. As only Level 1 variance estimates were significant, there is still more variance to be explained at Level 1 but not Level 2. A likelihood-ratio chi-squared test showed the addition of the attitudinal variables significantly improved the fit of the data, when compared to Model 4 ($\chi2$ (2) = 356.53, $p < .001$, *pseudo* R^2 = .05). Once again, the effect was small. The null hypothesis is rejected for H10 as responsibility belief was a significant predictor but failed to reject the null hypothesis for H11 as deflected beliefs were a non-significant predictor of unsafe crossing.

<u>Model 6: Two-Level Model with Fixed Level 1 and Level 2 Predictors and Varying Slopes</u>

This model will examine potential cross-level interactions. As neither of the school level predictors we were interested in this study (education and school location) were found to be significant by Model 5, and the small amount of variance at both levels that was being explained, no further exploration was conducted on Model 5. This final model ran through several iterations as it sought to examine cross level interactions between significant Level 1 and Level 2 predictors by varying the slopes on the lower-level variable of interest in the cross-level interaction. However, only one of the slopes was able to be assigned to random (accompanied by friends) due to lack of convergence when randomising the slopes of the remaining Level 1 variables of interest. On this basis, it was decided to proceed with the Raudenbush and Bryk's (2002) approach, where they suggest that a model with a cross-level interaction may omit the corresponding random slope if 'little or no variance in the slopes remains to be explained'. Location and education were significant predictors in Model 3 where they were first introduced, therefore, an examination of cross level interactions was conducted on the significant predictors based on this model with the inclusion of the Level 1 attitudinal and behaviour variables. This model tested H 12, 13 and 14.

In this model, the cross-level interactions on Location below were non-significant:

- Location x accompanied by a friend (p =.25)
- Location x accompanied by adults (p = .94)
- Location x gender (p = .06)
- Location x responsibility beliefs (p = .83)
- Location and deflected beliefs (p= .19)

There was a significant interaction between location and having a near – miss experience (β= 2.56, t(1034.20) = 2.27, p = .02). The experience of a near miss was a positive predictor for both rural (β = 6.44, p < .001) and urban schools (β = 8.99, p < .001) but with a much steeper slope in urban schools. It should be noted that there were significant effects for responsibility beliefs at both Level 1 (student) and Level 2 (school level). The lack of a significant interaction between Level 2 location and Level 1 responsibility beliefs may have been due to the inability to let the respective slope be assigned as random due to non-convergence. However, the interaction between location and higher frequency of being out around the roads on their own was significant (β= 2.55, t(1050.54) = 2.87, p = .004). This was a significant positive predictor at urban school location (β = .843 p < .001) increasing unsafe crossing but a negative non-significant predictor in rural schools (β = -.13, p < .001). Gender was a significant negative predictor (β= -1.76, t(1032.79) = -2.48, p = .02) with males reporting more unsafe crossing than females. Neither being accompanied by friends or adults were significant predictors of unsafe crossing in this model. However, the behaviour and attitudinal models were highly significant. Near miss was a significant positive predictor (β= 6.44, t(1028.75) = 9.04, p < .001) indicating that within their groups, children who reported having experienced a near miss also reported higher levels of unsafe crossing. Responsibility beliefs were a significant negative predictor (β= -1.43, t(1050.92) = -12.06, p < .001) demonstrating that within their group, children who reported higher level of responsibility beliefs reported lower levels of unsafe crossing. Deflected belief was a non-significant predictor. Education remained a significant Level 2 predictor (β= 3.12, t(39.28) = 3.32, p < .001). Finally, location of the school was a significant predictor (β= 4.28, t(39.49) = 4.54, p < .001) with children in urban schools reporting more unsafe crossing than those in rural schools. There was a significant interaction between school location and education (β= 3.32,

$t(38.92) = 2.39$, p =.02), where the presence of having road safety education was significantly associated with more unsafe crossing in urban schools only ($\beta = 1.25$*, p* < .001*).*

The Level 1 (43.79, CI:40.14; 47.78) and Level 2 variance was significant (5.5, CI:3.10; 9.76) at p <.001. The variation of the slopes for accompanied by a friend was also significant (p = .03. This indicates that there is still potentially more variance to be explained at Level 1 and Level 2. A likelihood-ratio chi-squared test showed the addition of the cross-level interaction with location and the demographic variables, along with the addition of the behaviour and attitudinal variables did not significantly improve the fit of the data when compared to Model 5. However, when compared to Model 3 which was the first model with Level 2 predictors, the addition of the cross-level interaction with location and the demographic variables, along with the addition of the behaviour and attitudinal variables did significantly improve the fit of the data ($\chi 2$ (7) = 569.53, p < .001, *pseudo* R^2 = .07). While there was a significant improvement in fit from Models 3 to Model 6, the effect size still remains small. The null hypothesis for H12 and H14 were rejected as there were significant interactions for two demographic variables (near miss and being out on roads on own and a significant interaction between school location and education).

A cross level interaction model was run in the same format as Model 6 to investigate H13 However, there were no significant interactions between Level 2 education and any of the Level 1 variables. Therefore, we failed to reject the null hypothesis for H13.

A second Model (Model 6b) was run to assess a series of Level 1 x Level 1 interactions, between 1) gender and 2) near-miss with the remaining Level 1 predictors. This model tested H15 and H16. However, there was just one significant interaction between gender and responsibility beliefs predictor (β= -.51, $t(1073.33) = -2.76$, p = .006) where higher responsibility beliefs resulted in lower unsafe crossing for females only. Therefore, the null hypothesis can be rejected for H15, but retained for H16. No further models were specified due to risk of over fitting the model, thereby limiting the generalisability to the wider population.

Table 4.26

Significant Predictors and Interactions Model 6 and Model 6 B Unsafe Crossing

Level 1	***β***	***p***	
Gender	-1.76	.02	Males higher unsafe crossing
Near Miss	6.44	< .001	Presence increase unsafe crossing
Responsibility Beliefs	-1.43	< .001	Higher beliefs decrease unsafe crossing
Level 2	***β***	***p***	
Education	3.12	< .001	Presence increases unsafe crossing
Location	4.28	<.001	Urban school higher unsafe crossing
Within Level Interaction	***β***	***p***	
Education x Location	3.32	.02	Urban: β = 1.25, p < .001
Gender x Responsibility Beliefs	-.51	.006	Higher beliefs, lower unsafe crossing females only
Cross Level Interaction	***β***	***p***	
Location x Near Miss	2.56	.02	Urban: β = 8.99, p < .001 Rural: β = 6.44, p < .001
Location x Out on Own	2.55	.004	Urban: β = .843 p < .001

Summary of findings from HLM ‘Unsafe Crossing’:

Unsafe Crossing: Overall, the final model (Model 6) provided the most sense theoretically, as it captured most of the strongest predictors that were observed across each model and highlighted some important interactions. At Level 1, males were more likely to report unsafe crossing, the negative impact of greater frequency of being on the roads on their own in urban school locations, the experience of a near miss on the road in both urban and rural school settings and finally, higher responsibility beliefs resulted in less unsafe crossing on the road. There was an observed interaction where higher responsibility beliefs resulted in lower unsafe crossing for females only. The location of the school indicated that those in urban schools were more likely to engage in unsafe crossing. There was an unexpected outcome across some of the models where children who had experienced RSA education programmes in their school, reported more unsafe crossing. It may have been assumed that those children who had RSA education demonstrated differences in their road safety beliefs. However, there was no cross-level interaction between schools with and without education and responsibility beliefs indicating that there was no impact at school level. However, analysis indicated a significant interaction between location and education where education was associated with greater unsafe crossing in urban schools only. As education failed to be a significant predictor in Model 5 once responsibility beliefs were included, and location was consistently the strongest predictor, it was concluded that the strongest influence on unsafe crossing was the urban location in which children both attend school and live. Therefore, based on the final model interactions and the strongest predictors across each iteration, unsafe crossing is more negatively impacted by the urban environment in which they attend school, live and socialise and strength of responsibility beliefs rather than education in primary school. Key areas which are very important to highlight are the strong predictive ability of previous near miss experiences, negative impact of greater frequency of being on the roads on their own in urban school locations, the positive impact of higher responsibility beliefs and the higher frequency with being around roads adults reducing unsafe crossing.

Section 4.4.3 HLM Analysis on ‘Planned Protective Behaviour’

As with the model building strategy used to investigate ‘unsafe crossing’, this section of analysis begins with a null, or empty model after which predictors are then added to the model in a forward or backward elimination approach. The overall fit of each model is assessed throughout the model building process. The independent variables and formal alternative hypotheses are the same as those set for unsafe crossing.

Model 1: Unconditional Model (random intercept model)

This model is used within this HLM framework to first ascertain the degree to which variance at Level 1 depends upon group membership at Level 2 and secondly to establish a baseline model from which subsequent models can be compared. Specifically, in this research, the null model asks how much schools vary in their mean ‘planned protective behaviour’.

This model allows the intercepts to randomly vary between schools. As no predictors are included in the model at Level 1, the intercepts are equal to the school means for the Level 1 outcome variable (i.e., planned protective behaviour). The results for the unconditional model demonstrate the mean regression coefficients for unsafe crossing varied significantly around the grand mean (β = 19.65, *P* < .001). The within group variance in 'planned protected behaviour' was 36.02 (CI: 33.07; 39.22) while the between group variance was 9.98 (CI: 6.10; 16.31) both of which were significant (*p* < .001) according to the Wald Z test (split p-value, Heck et al., 2014; Hox, 2017). This is the first indication of clustering. The intraclass correlation coefficient (ICC) was computed to allow further evaluation on the level of non-independence in the outcome at Level 1. The ICC for the null model was 0.22 indicating that 22% of the variation in reported 'planned protective behaviour' occurs between schools. Therefore, the ICC and test of the variance component for the first model (random intercept model) indicated significant clustering in the data which supported the use of HLM, as opposed to OLS regression, for data analysis. The null hypothesis is rejected as there is evidence of clustering.

Model 2: Fixed Level 1 Predictors and Randomly Varying Intercepts

This stage of the modelling strategy introduced Level I demographic predictors, gender, exposure and type of accompaniment when out around on the roads. These were included in a 'block entry' approach to examine the contribution of each and to also act as a control for the further addition of the behaviour and responsibility belief variables in further models. This model will test hypotheses 2, 3, 4, 5, and 6. Analysis yielded a main effect for exposure (β = .59, *t*(1058.04) = 5.74, *p* < .001) indicating that children within their group who reported higher levels of exposure, reported higher levels of planned protective behaviour. Gender was a significant positive predictor (β = .99, *t*(1058.04) = 2.49, *p* = .001) of reported planned protective behaviour, indicating that within their groups females tended to score higher on planned protective behaviour than males. All levels of accompaniment were significant predictors, albeit in different direction. Being out around the roads more frequently on their own (β = -.53, *t*(1058.04) = -3.74, *p* < .001) indicated that within their groups these children scored lower on planned protective behaviour. Similarly, those who were out around the roads more frequently with their friends (β = -.38, *t*(1058.04) = -2.35, *p*

= .02) also demonstrated that within their groups these children scored lower on planned protective behaviour. On the other hand, children who were out on the roads more frequently with adults (β = 1.38, t(1058.04) = 8.14, p <.001) demonstrated within their groups, higher levels of planned protective behaviour.

As with Model 1, both Level 1(31.49, CI: 28.92; 34.29) and Level 2 (10.19, CI: 6.29; 16.51) variance estimates are statistically significant (p <.001). Three times more of the variance occurs at student level. The ICC increased from .22 to .26 as when using CWC the intercepts are unadjusted for between-group differences on the predictor. Therefore, the ICC will get larger (relative to the null model) in a model including only Level 1 predictors. However, as both the Level 1 and 2 estimates were significant this indicates there is still substantial variance to be accounted for at each level. A likelihood-ratio chi-squared test showed the addition of the demographic variables significantly improved the fit of the data, when compared to the Model 1 ($\chi 2$ (5) = 142.01, p < .001, pseudo R^2 = .02). The null hypothesis was rejected for H 2, 3, 4, 5 and 6 as all demographic variables were significant predictors of planned protective behaviour.

Model 3: Fixed level 1 and Level 2 Predictors Randomly Varying Intercepts

Building on from Model 2, this third model incorporated the corresponding group level demographic variable (reintroducing the mean) and introduced two new Level 2 predictors (school location and education). This model can act as a control for when the Level 1 attitudinal and behaviour variables are included and will test H7 and H8. As with the previous model the demographic variables were all significant predictors at Level 1. Analysis yielded a main effect for exposure (β = .59, t(1058.33) = 5.79, p < .001) indicating that children within their group who reported higher levels of exposure, reported higher levels of planned protective behaviour. Gender was a significant positive predictor (β = .99, t(1058.33) = 2.49, p = .01) of reported unsafe crossing, indicating that within their groups females tended to score higher on planned protective behaviour than males. All levels of accompaniment were significant predictors albeit in different directions. Being out around the roads more frequently on their own (β = -.53, t(1058.) = -.374, p < .001) indicated that within their groups these children scored lower on planned protective behaviour. Similarly, those who were out around the roads more frequently with their friends (β = -.38, t(1058.33) = -.235, p =.02) also demonstrated that within their groups these children scored lower on planned protective behaviour. On the other hand, children who were out on the roads more frequently with adults (β = 1.38, t(1058.33) = 8.14, p <.001) demonstrated within their groups, higher levels of planned protective behaviour. Of the demographic predictors, only gender was significant at Level 2 (β = 3.14, t(39.83) = 2.22, p = .03) indicating that at school level females reported more planned protective behaviour. Of the two new Level 2 predictors, school location was a significant negative predictor (β = -4.21, t(39.38) = -3.22, p = .003) with children in urban schools reporting less planned protective behaviour than those in rural schools. Education was a non- significant predictor (β = .79, t(38.89) = 0.99, p = .325) indicating that there was no difference in planned protective behaviour depending on whether the RSA education programmes were in the school or not.

As with Model 2, both Level 1(31.49, CI:28.91; 34.29) and Level 2 (2.83, CI: 1.59; 5.27) variance estimates are statistically significant (p <.001). The ICC decreased to .08 indicating that 8% of the variation in reported 'planned protective behaviour' occurs between schools. However, the larger amount of the variance is at student level. As both variance estimates were significant, there is still more variance to be explained at both levels. A likelihood-ratio chi-squared test showed the addition of the Level 2 variables significantly improved the fit of the data, when compared to Model 2 ($\chi 2$ (7) = 43.09, p < .001, *pseudo* R^2 = .01) but the effect size was small. Location (H7) was a significant predictor, therefore we reject the null hypothesis, however, we failed to reject the null hypothesis for H8, as education was a non-significant predictor.

Model 4: Two-Level Model with Fixed Level 1 and Level 2 Predictors and Randomly Varying Intercepts

This model included an additional behaviour predictor (near miss) at Level 1 and Level 2 to account for the additional variance yet to be explained. This model tested H9. Only significant Level 1 and Level 2 predictors from Model 3 were carried forward to this model. Initial analysis indicated that accompanied by friends was now not a significant predictor and was removed and Model 4 re-run. As with the previous model, exposure was a significant predictor (β = .60, t(1058.29) = 5.9, p < .001) indicating that within their groups, children who had greater exposure to the roads reported higher levels of planned protective behaviour. Gender was also a significant positive predictor (β = .87, *t*(1058.29) = 2.18, *p* = .003) of reported planned protective behaviour, indicating that within their groups females tended to score higher on planned protective behaviour than males. Being out around the roads more frequently on their own was a significant negative predictor (β = -.51, *t*(1058.29) = -.366, *p* < .001) indicating that within their groups these children scored lower on planned protective behaviour. Being out around the roads more frequently with friends was a non-significant negative predictor (β = -.28, *t*(1058.29) = -1.70, *p* =.09). On the other hand, the more frequently children were on the road with adults was a significant positive predictor (β = 1.28, *t*(1058.29) = 7.6, *p* <.001) demonstrating within their groups, higher levels of planned protective behaviour. Having a near miss was a significant negative predictor at both Level 1 (β = -2.17, *t*(1058.29) = -.49, *p* <.001) and Level 2 (β = -6.28, *t*(43.66) = -2.47, *p* = .02). This suggests that as well as children who reported having a near miss within their group reporting lower levels of planned protective behaviour, children who were attending schools with higher proportion of near miss experiences were more likely to report lower levels of planned protective behaviour. Possible interactions will be examined in subsequent models. Gender was a significant predictor at Level 2 (β = 3.71, *t*(41.4) = 2.87, *p* =.006) demonstrating that across schools, females reported greater planned protective behaviour than males. Finally, location was a significant negative predictor (β = -3.02, *t*(43.78) = -3.04, *p* =.004) with children in urban schools reporting less planned protective behaviour than those in rural schools.

As with Model 3, both Level 1(30.80, CI:28.28; 33.54) and Level 2 (3.07, CI: 1.68; 5.6) variance estimates are statistically significant (*p* <.001). The ICC increased from .08 to .09 indicating that now 9% of the variation in reported ‘planned protective behaviour’ occurs between schools. However, as both variance estimates were significant, there is still more variance to be explained at both levels. A likelihood-ratio chi-squared test showed the addition of the near miss variables significantly improved the fit of the data, when compared to Model 3 ($\chi 2$ (3) = 21.16, *p* < .001, *pseudo* R^2 = .003). While there was a significant improvement in fit from Model 3 to Model 4, it was a very small effect size. We reject the null hypothesis for H9 as near-miss was a significant predictor of planned protective behaviour.

Model 5: Two-level Model with Fixed Level 1 and Level 2 Predictors and Randomly Varying Intercepts

This model included the final Level 1 attitudinal predictors (responsibility beliefs and deflected beliefs) to account for the additional variance yet to be explained. This model tested H10 and H11. Only variables that were significant in Model 4 were carried forward to this model. Exposure was a significant predictor (β = .61, t(1052.17) = 6.32, p < .001) indicating that within their groups, children who had greater exposure to the road reported higher planned protective behaviour. Gender was a non-significant predictor (β = 0.62, t(1052.19) = 1.61, p = .11) of planned protective behaviour. Being out around the roads more frequently on their own was a significant predictor (β = -.51, t(1052.16.) = -3.73, p < .001) indicating that within their groups these children scored lower on planned protective behaviour. On the other hand, children who were out on the roads more frequently with adults (β = 1.14, t(1052.16) = 6.90, p < .001) demonstrated within their groups, higher levels of planned protective behaviour. Having a near miss was a significant negative predictor at Level 1 (β = -1.43, t(1052.16) = -3.25, p =.001) whereas near miss at Level 2 was non-significant (β = -2.90, t(39.07) = -1.18, p =.25). This suggests that children who reported having a near miss within their group reported lower levels of planned protective behaviour, however, it was not a significant predictor at school level. The new attitudinal variable, responsibility beliefs was a significant positive predictor at both Level 1 (β = 0.47, t(1052.17) = 7.76, p <.001) and Level 2 (β = 0.72, t(37.49) = 2.35, p =.02). This suggests that as well as children who reported higher responsibility beliefs within their group reporting higher levels of planned protective behaviour, children who were attending schools with a higher mean level of responsibility beliefs were more likely to report higher levels of planned protective behaviour. Possible interactions will be examined in future models. Deflected belief was a significant negative predictor at Level 1 (β = -0.17, t(1052.12) = -2.12, p =.03) and at Level 2 (β = -1.49, t(36.82) = -2.63, p =.01). This suggests that not only children who scored higher within their groups on deflected beliefs reported lower planned protective behaviour but also children in schools with higher mean deflected beliefs also reported lower planned protective behaviour. Therefore, it was a significant predictor at both student and school levels. Gender was a non-significant predictor at Level 2 (β = 2.43, t(36.37) = 1.96, p =.06). Finally, location was a significant negative predictor (β = -3.36, t(39.48) = -3.70, p < .001) indicating that children in urban school reported lower levels of planned protective behaviour than children in rural schools.

Level 1 variance (28.97, CI:26.60; 31.56) and Level 2 variance (2.05, CI: 1.01; 4.16) was significant at $p < .001$. The ICC decreased from.11 to .07 indicating that 7% of the variation in reported 'planned protective behaviour' occurs between schools. As both Level 1 and Level 2 variance estimates were significant, there is still more variance to be explained at both levels. A likelihood-ratio chi-squared test showed the addition of the attitudinal variables significantly improved the fit of the data, when compared to Model 4 ($\chi2$ (3) = 89.35, $p < .001$), *pseudo* R^2 = .01, however, the effect size was small. We reject the null hypothesis H10, as responsibility beliefs were a significant predictor of planned protective behaviour and we reject H11 as deflected beliefs was a significant predictor.

Model 6: Two-level Model with Fixed Level 1 and Level 2 Predictors and Varying Slopes

As neither of the school level predictors we were interested in this study (education and school location) were found to be significant by Model 5 and the small amount of variance at both levels that was being explained, no further exploration was conducted on Model 5. This final model ran through several iterations as it sought to examine cross level interactions between significant Level 1 and Level 2 predictors by varying the slopes on the lower-level variable of interest in the cross-level interaction. However, only two of the slopes were able to be assigned to random (gender and accompanied by friends) due to lack of convergence with each of the other attempts with the remaining demographic variables. On this basis, it was decided to proceed with the Raudenbush and Bryk's (2002) approach where they suggest that a model with a cross-level interaction may omit the corresponding random slope if 'little or no variance in the slopes remains to be explained' due to the low level of total variance in this model. Location was a significant predictor in Model 3 where it was first introduced, therefore, an examination of cross level interactions was conducted on the significant predictors based on this model with the inclusion of the attitudinal and behaviour variables. By model 3, education was a non-significant predictor and as such was excluded therefore, this model tested H12 only.

In this model, the cross-interactions on Location below were non-significant:

- Location x accompanied by a friend (*p* =.73)
- Location x accompanied by adults (*p* = .86)
- Location x being out around the road on their own (*p* = .21)
- Location x exposure (p = .12)
- Location x responsibility beliefs (*p* = .21)
- Location and deflected beliefs (*p*= .25)
- Location x near-miss (*p* = .14)

It should be noted that in Model 5 there were significant effects for responsibility beliefs at both Level 1 (student) and Level 2 (school level). The lack of a significant interaction between location and this variable may have been due to the inability to let the respective slope be assigned as random due to non-convergence. Gender was a significant positive predictor (β= .1.98, *t*(45.17) = 3.10, *p* = .003) with females demonstrating more planned protective behaviour than males. However, the interaction between location and gender was significant (β= -2.55, *t*(38.32) = -2.96, *p* = .006) with females demonstrating significantly higher planned protective behaviour (β = 1.90, *p* = .001) in rural school locations than males but there was a non-significant negative slope for urban schools (β = -0.59, *p* = .23) . The higher frequency of being accompanied by an adult was a significant predictor (β= 1.03, *t*(1045.41) = 3.86, *p* < .001) with these children reporting more planned protective behaviour. Neither accompanied by friends nor being out on the roads on their own frequently were significant predictors of planned protective behaviour in this model. Higher levels of exposure to the roads was also a significant predictor (β= .81, *t*(1052.84) = 5.03, *p* < .001) with higher levels of exposure resulting in more reported planned protective behaviour. However, the behaviour and attitudinal models were significant. Near miss was a significant negative predictor (β= -1.82, *t*(1032.56) = -3.19, *p* < .001) indicating that within their groups, children who reported having experienced a near miss also reported lower levels of planned protective behaviour. Responsibility beliefs were a significant positive predictor (β= 0.56, t(1052.24) = 5.95, *p* < .001) demonstrating that within their group, children who reported higher level of responsibility beliefs reported greater planned protective behaviour. Deflected beliefs was a non-significant predictor (β= -.07, t(1045.72) = -6.4, *p* = .53) . Finally school location was significant negative predictor (β = -4.59, *t*(40.96) = -5.98, *p* < .001) with children in urban schools reporting less planned protective behaviour than those in rural schools.

The Level 1 (27.76, CI:25.42; 30.32) and Level 2 variance was significant (5.02, CI:2.95; 8.55) at p <.001. The variation of the slopes for accompanied by a friend (p = .32 and gender (p = .39) were non-significant. This indicates that there is still potentially more variance to be explained at Level 1 and Level 2. A likelihood-ratio chi-squared test showed the addition of the cross-level interaction with location and the demographic variables, along with the addition of the behaviour and attitudinal variables did significantly not significantly improve the fit of the data when compared to Model 5. However, when compared to Model 3 which was the first model with Level 2 predictors, the addition of the cross-level interaction with location and the demographic variables, along with the addition of the behaviour and attitudinal variables did significantly improve the fit of the data ($\chi2$ (7) = 111.19, p < .001, *pseudo* R^2 = .01). While there was a significant improvement in fit from Models 3 to Model 6, the effect size still remains small. The null hypothesis was rejected for H12 as there were significant cross-level interactions between location and gender.

A second Model (Model 6b) was run to assess a series of Level 1 x Level 1 interactions, between 1) gender and 2) near-miss with the remaining Level 1 predictors. This model tested H15 and H16. However, there were no significant interactions at Level 1 for planned protective behaviour. Therefore, the null hypothesis is accepted for H15 and H16. No further models were specified due to risk of over fitting the model, thereby limiting the generalisability to the wider population. Table 4.27 sets out a summary of the significant predictors and interactions.

Table 4.27

Significant Predictors and Interactions Model 6 and Model 6 B Planned Protective Behaviour

Level 1	***β***	***p***	
Gender	1.98	.003	Females more planned protective behaviour
Adult present	1.03	< .001	Presence increases planned protective behaviour
Exposure	.81	< .001	Higher exposure more planned protective behaviour
Near Miss	-1.82	< .001	Presence decreases planned protective behaviour
Responsibility Beliefs	0.56	< .001	Higher increase planned protective behaviour
Level 2	***β***	***p***	
Location	-4.59	<.001	Urban school less planned protective behaviour
Cross Level Interaction	***β***	***p***	
Location x gender	-2.55	.006	Rural: $\beta = 1.90$ $p < .001$ (Females higher)

Summary of HLM for Planned Protective Behaviour:

Overall, the final Model 6 provided the most sense theoretically as it retained the strongest predictors that were observed across each model. The variables that remained constant across each iteration were, being female, the positive impact of higher levels of exposure to the road environment, the positive impact of being accompanied by an adult and the positive impact of holding higher responsibility beliefs. Negative predictors included an experience of a near miss on the road which was more likely to predict less planned protective behaviour. The location of the school indicated that those in rural schools, in particular females, were more likely to engage in planned protective behaviour than children of either gender in urban schools. Education did not impact planned protective behaviour. Therefore, in this study, planned protective behaviour on the road was more impacted by the environment in which they attend school and live, the level and type of accompaniment (negative with friends, positive with adults) and having stronger responsibility beliefs, rather than education at primary school level.

Section 4.4.4 HLM Analysis on 'Dangerous Play on the Road'

As with the model building strategy used to investigate 'unsafe crossing' and 'planned protective behaviour', this section of analysis begins with a null, or empty model after which predictors are then added to the model in a forward or backward elimination approach. The overall fit of each model is assessed throughout the model building process. The formal alternative hypotheses the same as those stated at the start of Section 4.4.2.

Model 1: Unconditional Model (random intercept model)

This model is used within this HLM framework to first ascertain the degree to which variance at Level 1 depends upon group membership at Level 2 and secondly to establish a baseline model from which subsequent models can be compared. Specifically, in this research, the null model asks how much schools vary in their mean 'dangerous play on the road' score.

This model allows the intercepts to randomly vary between schools. As no predictors are included in the model at Level 1, the intercepts are equal to the school means for the Level 1 outcome variable (i.e., dangerous play on the road). The results for the unconditional model demonstrate the mean regression coefficients for unsafe crossing varied significantly around the grand mean ($\beta = 12.98$, $p < .001$). The within group variance in 'dangerous play on the road' was 17.68 (CI: 16.25; 19.27) while the between group variance was 2.57(CI:1.48; 4.44) both of which were significant ($p < .001$) according to the Wald Z test (split p-value, Heck et al., 2014; Hox, 2017). This is the first indication of clustering. The intraclass correlation coefficient (ICC) was computed to allow further evaluation on the level of non-independence in the outcome at Level 1. The ICC for the null model was 0.13 indicating that 13% of the variation in reported 'dangerous play on the road' occurs between schools. Therefore, the ICC and test of the variance component for the first model (random intercept model) indicated significant clustering in the data which supported the use of HLM, as opposed to OLS regression, for data analysis. The null hypothesis is rejected as there is evidence of clustering in the data.

Model 2: Fixed level 1 Predictors and Randomly Varying Intercepts

This stage of the modelling strategy introduced Level I demographic predictors, gender, exposure and type of accompaniment when out around on the roads. These were included in a 'block entry' approach to examine the contribution of each and to also act as a control for the further addition of the behaviour and responsibility belief variables in further models. This model will test hypotheses 2,3,4,5 and 6.

Analysis yielded a non-significant effect for either gender or frequency of being out around the roads on their own. Therefore, these were removed and the analysis re-run. The new Model 2 found a main effect for exposure (β = .33, *t*(1058.14) = 4.59, *p* < .001) indicating that children within their group who reported higher levels of exposure, reported higher levels of dangerous play on the road. Being out around the roads more frequently with their friends was a significant positive predictor (β = 604, *t*(1058.14) = 5.23, *p* < .001) demonstrating that within their groups these children scored higher in dangerous play on the road. On the other hand, children who were out on the roads more frequently with adults was a negative predictor (β = -.48, *t*(1058.14) = -3.96, *p* <.001) demonstrating within their groups, lower levels of dangerous play on the road.

As with Model 1, both Level 1(16.47, CI: 15.13; 17.94) and Level 2 (2.61, CI: 1.53; 4.48) variance estimates are statistically significant (*p* <.001). The overall variance explained in this model is very small. The ICC increased from .13 to .14 as when using CWC, the intercepts are unadjusted for between-group differences on the predictor. Therefore, the ICC will get larger (relative to the null model) in a model including only Level 1 predictors. However, as both the Level 1 and 2 estimates were significant this indicates there is still substantial variance to be accounted for at each level. A likelihood-ratio chi-squared test showed the addition of the demographic variables significantly improved the fit of the data, when compared to the Model 1 ($\chi 2$ (3) = 76.07, *p* < .001, pseudo R^2 = .01). The null hypothesis was accepted for H2 and H5 as neither gender nor frequency of being out on the roads on their own were significant predictors of dangerous play on the road. However, the null was rejected for H3, 4 and 6 as frequency of being accompanied by either a friend or adults and the level of exposure to the roads were significant predictors of dangerous play on the road.

Model 3: Fixed level 1 and Level 2 Predictors Randomly Varying Intercepts

Building on from Model 2, this third model incorporated the corresponding significant group level demographic variables (reintroducing the mean) and introduced two new Level 2 predictors (school location and education). This model can act as a control for when the level 1 attitudinal and behaviour variables are included and tested H7 and H8. As with the previous model, the demographic variables were all significant predictors at Level 1. Analysis yielded a main effect for exposure (β = .33, t(1056.88) = 4.59, p < .001) indicating that children within their group who reported higher levels of exposure, reported higher levels of dangerous play on the road. Being out around the roads more frequently with their friends was a significant positive predictor (β = .60, t(1056.88) = 5.22, p < .001) demonstrating that within their groups these children scored higher on reported dangerous play on the road. On the other hand, children who were out on the roads more frequently with adults (β = -.48, t(1056.88) = -3.96, p <.001) demonstrated within their groups, lower levels of dangerous play on the road. None of the demographic predictors were significant at Level 2. The new Level 2 predictor school location, was a positive predictor (β = 2.38, t(36.96) = 3.91, p < .001) with children in urban schools reporting more dangerous play on the road than those in rural schools. Education was a significant positive predictor (β = 1.20, t(33.83) = 2.96, p = .006) indicating that children in schools which provided road safety education reported higher levels of dangerous play on the road.

As with Model 2, both Level 1(16.49, CI:15.14; 17.96) and Level 2 (0.46, CI: 0.16; 1.33) variance estimates are statistically significant (p <.001; p = .03). The ICC decreased to .03 indicating that only 3% of the variation in reported ‘dangerous play on the road’ occurs between schools. However, the variance at student level is also very small. As both variance estimates were significant, there is still more variance to be explained at both levels. A likelihood-ratio chi-squared test showed the addition of the Level 2 variables significantly improved the fit of the data, when compared to Model 2 ($\chi2$ (5) = 43.41, p < .05, *pseudo* R^2 = .007) but the effect size was incredibly small. The null hypothesis was rejected for H7 and H8 as both location and education were significant predictors of dangerous play on the road.

Model 4: Two-level Model with Fixed Level 1 and Level 2 Predictors and Randomly Varying Intercepts

This model included an additional behaviour predictor (near miss) at Level 1 and Level 2 to account for the additional variance yet to be explained. This model tested H 9. Only significant Level 1 and Level 2 predictors from Model 3 were carried forward to this model. As with the previous model, exposure was a significant predictor (β = .30, t(1062.61) = 4.65, p < .001) indicating that within their groups, children who had greater exposure to the roads reported higher levels of dangerous play on the road. Being out around the roads more frequently with their friends was also a significant positive predictor (β = .36, t(1062.61) = 3.50, p < .001) demonstrating that within their groups these children scored higher on reported dangerous play on the road. On the other hand, the greater frequency children were on the roads with adults was a significant negative predictor (β = -.23, t(1062.61) = -2.11, p = .04) demonstrating within their groups, lower levels of dangerous play on the road. Having a near miss was a significant positive predictor at both Level 1 (β = 5.12, t(1062.61) = 18.02, p <.001) and Level 2 (β = 7.66, t(46.99) = 8.15, p <.001). This suggests that as well as children who reported having a near miss within their group reporting higher levels of dangerous play on the road, children who were attending schools with higher proportion of near miss experiences were more likely to report higher levels of dangerous play on the road. Possible interactions will be examined in future models. Education was a significant predictor (β = 0.64, t(28.68)= 2.56, p =.02) again suggesting that children in their groups who attended a school with road safety education reported more dangerous play on the road. Finally, location was a non-significant predictor (β = 0.58, t(32.39)= 1.5, p =.14).

Only Level 1 variance (12.6, CI:11.57;13.72) was significant (p <.001) with Level 2 variance estimates returning a value of 0. Therefore, an ICC cannot be calculated and indicated that now there is no variance left to be explained at school level in this model with the current variables. However, as Level 1 variance estimates were significant, there is still potentially more variance to be explained here. A likelihood-ratio chi-squared test showed the addition of the near miss variables significantly improved the fit of the data, when compared to Model 3 ($\chi2$ (1) = 318.73, p < .001, *pseudo* R^2 = .05). While there was a significant improvement in fit from Model 3 to Model 4, it remains a small effect size.

Model 5 (a) and (b): Two-level Model with Fixed Level 1 and Level 2 Predictors and Randomly Varying Intercepts

This model included the final Level 1 attitudinal predictors (responsibility beliefs and deflected beliefs) to account for the additional variance yet to be explained. This model tested H10 and H11. Only variables that were significant in Model 4 were carried forward to this model. As there was no variance to be explained at Level 2, reinserting the mean for the two attitudinal variables at Level 2 resulted in a non-convergence in the model, therefore these attitudinal variables were only entered as Level 1 predictors in Model 5 (a).

Model 5(a): Exposure was a significant predictor (β = .26, $t(1061.37) = 4.24$, $p < .001$) indicating that within their groups, children who had greater exposure to the road reported higher dangerous play on the road. Being out around the roads more frequently with friends was a significant predictor (β = .32, $t(1061.44) = 3.27$, $p < .001$) indicating that within their groups these children scored higher on dangerous play on the road. The higher frequency of children being out on the roads with adults was a non- significant predictor (β = -.08, $t(1061.36) = -.83$, $p = .40$). Having a near miss was a significant predictor at Level 1 (β = 4.52, $t(1061.35) = 16.09$, $p < .001$) and at Level 2 (β = 8.72, $t(47.03) = 14.94$, $p < .001$). This suggests that children who reported having a near miss within their group reported higher levels of dangerous play on the road, and children in schools with a greater proportion of near miss experiences also reported more dangerous play on the road. This indicates that near miss experience was a significant predictor at both student and school level. The new attitudinal variable, responsibility beliefs was a significant negative predictor at Level 1 (β = -.35, $t(1061.41) = -9.05$, $p < .001$), whereas deflected beliefs was a non-significant predictor (β = 0.02, $t(1061.35) = .53$, $p = .60$).This indicates that children who had higher responsibility beliefs demonstrated less dangerous play on the road. Education was a non-significant predictor (β = 0.41, $t(42.49) = 1.83$, $p = .07$).

Level 1 variance (11.65,CI:10.69; 12.68) was significant at $p < .001$, however, Level 2 variance (.06, CI: .002; 1.74) was non-significant at $p = .56$. The ICC decrease was .003, indicating that a minimal amount of variance in 'dangerous play on the road' in this model occurs between schools. As Level 1 variance estimates were significant, there is still more variance to be explained. A likelihood-ratio chi-squared test showed the addition of the attitudinal variables significantly improved the fit of the data, when compared to Model 4 ($\chi 2$ (1) = 91.463, $p < .05$, pseudo $R^2 = .02$, however, the effect size was small.

The level of variance left to be explained caused a challenge for the modelling strategy. Near -miss has been found to be a significant predictor at both Level 1 and Level 2 in previous models, however, the decision was made to exclude the Level 2 near miss due to non-convergence. This allowed for an examination of the attitudinal variable responsibility beliefs as it was a significant predictor in Model 5 (a) at both Level 1 and Level 2. Other non-significant predictors form the previous model were also excluded.

Model 5 (b): As with the previous model, exposure remained a significant predictor (β = .25, t(1058.14) = 4.19, $p < .001$) indicating that within their groups, children who had greater exposure to the roads reported higher levels of dangerous play on the road. Being out around the roads more frequently with their friends was also a significant positive predictor (β = .33, t(1058.14) = 3.36, $p < .001$) demonstrating that within their groups these children scored higher on reported dangerous play on the road. Having a near miss was a significant positive predictor at Level 1 (β = 4.54, t(1058.14) = 16.23, p <.001) .This suggests that children who reported having a near miss within their group reported higher levels of dangerous play on the road. Responsibility beliefs was a significant negative predictor at Level 1 (β = -.35, t(1058.14)= -0.44, $p < .001$) and Level 2 (β = -.95, t(42.44)= -4.11, $p < .001$). This indicates that children who reported higher levels of responsibility beliefs within their groups reported less dangerous play on the road, and children within schools with higher levels of responsibility beliefs also reported less dangerous play on the road. Therefore, responsibility beliefs are significant predictors at both student and school level.

Level 1 (11.67, CI:10.72; 12.71) and Level 2 variance was significant (1.86, CI:1.09; 3.19) at p <.001. The ICC indicated that 14% of the variance in this model was left to be explained at school level. This indicates that there is still potentially more variance to be explained at both levels. A likelihood-ratio chi-squared test showed the addition of the attitudinal variables did not significantly improve the fit of the data, when compared to Model 5(a) as there was an increase in the -2 Log Likelihood. However, when compared to Model 4, there was a significant improvement in the fit of the data, ($\chi 2$ (1) = 16.36, $p < .01$, *pseudo* R^2 = .002). While there was a significant improvement in fit from Model 4 to Model 5(b), it remains a very small effect size. The null hypothesis was rejected for H10 as responsibility beliefs were a significant predictor of dangerous crossing, however, we failed to reject the null hypothesis for H11 as deflected beliefs did not significantly predict dangerous play on the road.

Model 6: Two-Level Model with Fixed Level 1 and Level 2 Predictors and Varying Slopes

As neither of the school level predictors we were interested in this study (education and school location) were found to be significant by Model 5 and the small amount of variance at both levels that was being explained, no further exploration was conducted on Model 5. This final model ran through several iterations as it sought to examine cross level interactions between significant Level 1 and Level 2 predictors by varying the slopes on the lower-level variable of interest in the cross-level interaction. However, only one of the slopes were able to be assigned to random (accompanied by friends) due to lack of convergence with each of the other attempts with the remaining demographic variables. On this basis, it was decided to proceed with the Raudenbush and Bryk's (2002) approach where they suggest that a model with a cross-level interaction may omit the corresponding random slope if 'little or no variance in the slopes remains to be explained' due to the low level of total variance in this model.

Education and location were significant predictors in Model 3, therefore, an examination of cross levels interactions was conducted on this model with the addition of the strong predictors experience of a 'near-miss' and responsibility beliefs. The model focused on the cross-level interactions at location only. Gender and deflected beliefs were not included in this model due to non- significance as Level 1 predictors of dangerous play on the road. This model tested H 12, 13 and 14.

In this model, the cross-level interactions on Location below were non-significant:

- Location x accompanied by a friend (p =.97)
- Location x accompanied by adults (p = .32)
- Location x being out around the road on their own (p = .08)
- Location x near-miss (p = .66)

It should be noted that across the models there were significant effects for near miss at both Level 1 (student) and Level 2 (school level). The lack of a significant interaction between location and this variable may have been due to the inability to let the respective slope be assigned as random due to non-convergence. However, the interaction between location and exposure was significant (β= .27, *t*(1054.70) = 2.14, *p* = .03), demonstrating that children in urban schools with higher levels of exposure demonstrate significantly higher levels of dangerous play on the road (β= .34, *p* < .001) than children in rural schools (β= .07, *p* = .50). There was a significant interaction between location and responsibility beliefs (β= -.22, t(1054.72) = -2.89, *p* = .004), demonstrating that children in urban schools with higher levels of responsibility beliefs demonstrate significantly lower levels of dangerous play on the road (β= .31, p < .001) than children in rural schools (β= .19, p = .50). The frequency of being accompanied by friends was a significant positive predictor (β= .32, *t*(1054.72) = 2.01, *p* = .04) leading to more dangerous play on the road. Being accompanied by adults or the frequency of being out on their own and exposure were all non-significant in this model. However, the behaviour and attitudinal models were significant predictors. Near miss was a significant positive predictor (β= 4.59, *t*(1054.70) = 12.46, *p* < .001) indicating that within their groups, children who reported having experienced a near miss also reported higher level of dangerous play on the road. Responsibility beliefs were a significant negative predictor (β= -.24, *t*(1054.73) = -3.63, *p* < .001) demonstrating that within their group, children who reported higher level of responsibility beliefs reported lower dangerous play on the road. Education was a significant positive predictor (β= 1.58, *t*(38.78) = 2.71, *p* = .01) indicating that children who were in a school with road safety education demonstrated more dangerous play. Location was a significant positive predictor (β= 3.32, *t*(36.47) = 5.82, *p* <.001) There was a significant interaction between school location and education (β= 2.38, *t*(38.28) = 3.32, *p* < .001) demonstrating that education was only a significant predictor of dangerous play in urban schools (β= 1.07, *p* < .001).

The Level 1 (11.39, CI:10.46; 12.41) and Level 2 variance was significant (0.83, CI:0.42; 1.64) at *p* <.001. The variation of the slope for accompanied by a friend was non-significant (*p* =.09) This indicates that there is still potentially more variance to be explained at both levels. A likelihood-ratio chi-squared test showed the addition of the cross level interaction with location and the demographic variables, along with the addition of the behaviour and attitudinal variables did significantly improve the fit of the data, when compared to Model 2, ($\chi 2$ (15) = 439.50, p < .001, *pseudo* R^2 = .07) which just contained the level one demographic variables and Model 3, ($\chi 2$ (7) = 396.11, p < .001, *pseudo* R^2 = .06) which contained Level I demographic predictors along with Level 2 predictors. While there was a significant improvement in fit from Models 2 and 3 to Model 5, the amount of overall variance explained is very small and the effect size still remains small. However, this final model had the lowest -2 Log Likelihood value and made the most sense, theoretically as given set of predictors. The null hypothesis was rejected for H12 as there was evidence of a significant interaction between exposure to the road, responsibility beliefs and location, however, the null hypothesis for H13 is accepted as there were no significant interactions between education and any of the level 1 predictors. The null hypothesis was also rejected for H14 as there was a significant interaction between school location and road safety education.

A second Model (Model 6b) was run to assess a series of Level 1 x Level 1 interactions, between 1) gender and 2) near-miss with the remaining Level 1 predictors. This model tested H15 and H16. However, there was just one positive significant interaction between near miss and exposure (β= .41, t(1068.87) = 2.23, p = . 02), where exposure was only a significant predictor of dangerous play when recording a near miss experience. Therefore, the null hypothesis is accepted for H15 and rejected for H16. No further models were specified due to risk of over fitting the model, thereby limiting the generalisability to the wider population. Table 4.28 summarises the significant predictors and interactions in Model 6.

Table 4.28

Significant Predictors and Interactions Model 6 and Model 6 B Dangerous Play on Road

Level 1	***β***	***p***	
Friends present	.32	< .001	Presence increase dangerous play
Near Miss	4.59	< .001	Presence increased dangerous play
Responsibility Beliefs	-.24	< .001	Higher decrease dangerous play
Level 2	***β***	***p***	

Education	1.58	.01	Presence increased dangerous play
Location	3.32	<.001	Urban school more dangerous play
Within Level Interaction	***β***	***p***	
Education x Location	2.38	<.001	Urban: β= 1.07, p < .001 (presence increased in urban location only)
Exposure x Near Miss	.41	.02	Exposure significant when near miss present
Cross Level Interaction	***β***	***p***	
Location x Exposure	.27	.03	Urban: β= .34, p < .001 (higher exposure higher dangerous play)
Location x Responsibility Beliefs	-.22	.004	Urban: β= .31, p < .001 (higher beliefs, lower dangerous play)

Summary of HLM for Dangerous play on the road:

Dangerous Play on the Road: Overall, the final model (Model 6) provided the most sense theoretically as it captured the strongest predictors that were observed across each model. The variables that remained constant across each iteration until the final model, were the impact of higher levels of exposure to the road environment, the negative impact of greater frequency of being on the roads or with friends and the positive impact of being accompanied by a parent. Having an experience of a near miss on the road was likely to predict more dangerous play on the road, while having higher responsibility beliefs resulted in less dangerous play on the road. The location of the school indicated that those in urban schools were more likely to engage in dangerous play on the road. It should be further noted that children in urban schools with higher levels of exposure demonstrated significantly higher levels of dangerous play on the road. Those children with higher levels of responsibility beliefs demonstrated lower levels of dangerous play on the road in urban areas than those in rural locations. There was an unexpected outcome across some of the models where children who had experienced RSA education programmes in their school, reported more dangerous play on the roads as in unsafe crossing. It may have been assumed that those children who had RSA education demonstrated differences in their road safety beliefs. However, there was no cross-level interaction between schools with and without education and responsibility beliefs as observed with the location, indicating that there was no impact of education on beliefs at school level.

On the other hand, a same level interaction demonstrated a significant interaction between school location and education where education was only a significant predictor of dangerous play in urban schools only. Education failed to reach significance in Model 5 once responsibility beliefs were included, as in unsafe crossing. Further, the significant interaction between responsibility beliefs and location needs to be considered. Therefore, just as in the unsafe crossing factor, it is suggested that the strength of the urban location as a predictor is driving the observed relationship between education and dangerous play. Separate to this final model, experience of a near miss interacted with levels of exposure indicating that exposure was only a significant predictor of dangerous play when recording a near miss experience Therefore, it is clear in this study, dangerous play on the road is more impacted by the urban environment in which they attend school, live and socialise and their responsibility beliefs than education at primary school level. These finding are discussed in considerable detail with reference to previous literature and theoretical constructs underpinning the behaviours. Overall, the presence of the cross-level interactions clearly demonstrated the efficacy of running these analysis through HLM rather than Hierarchical linear regression due to the obvious impact of clustering at school level.

Section 4.4.6 Comparison of Predictors Across Dependent Variables

The use of HLM allowed the impact of predictors at student level and group level to be assessed due to the presence of clustering within the school structure. Across all three behaviours assessed, unsafe crossing, planned protective behaviour and dangerous play on the road, there are predictors which remain strongly consistent across each.

Location: Location, in particular an urban location has maintained a strong relationship across both the ANOVA modelling and the HLM analysis. Children in urban schools demonstrated more unsafe crossing, more dangerous play and less planned protective behaviour. A closer examination of the unsafe crossing outcome revealed that a higher frequency of being out around the roads on their own and having the experience of a near miss were all strongly related to the urban environment of the school. Regarding dangerous play, the greater the level of exposure to the roads children had, the more dangerous play they participated in, within an urban location. Children in urban schools of both genders participated in less planned protective behaviour than those in rural schools where only females were more likely to behave in that manner. An interesting finding was that of the interaction between education and location for unsafe crossing and dangerous play. In the corresponding ANOVA analysis, school location had three levels (rural, small, large urban) with evidence of a significant main effect of education on more unsafe crossing and dangerous play. There was no interaction between school location or education to aid an explanation of this. However, in the HLM analysis, school location was a dichotomous variable (rural, urban). While education was a significant predictor of unsafe crossing, a significant interaction indicated that this was in urban schools only. Across each model, location was consistently stronger than education, therefore, the relationship we have observed may be driven simply by the urban location in which the behaviour occurs.

Near Miss: Having an experience of a near miss was strongly predictive of more unsafe crossing and dangerous play and less planned protective behaviour. This may enable parents and guardians to gain a stronger sense of their child's road use behaviour if they have noted at least one near miss experience (provided this was due to the child's unsafe crossing or dangerous play rather than a driver breaking a pedestrian light etc.).

Responsibility beliefs: The next strongest predictor across each, was the holding of higher responsibility beliefs which resulted in more planned protective behaviour and less dangerous play and unsafe crossing. This attitudinal variable was significant at both student level and at location, a level two predictor. For unsafe crossing, higher responsibility beliefs resulted in less unsafe crossing for femlaes only. In the dangerous play model, it was observed that higher responsibility beliefs resulted in significantly lower dangerous play on the road in urban locations than in rural location.This has strong implications for the instillation of stronger personal responsibility beliefs in both genders as it has the power to positively impact more safe behaviour as pedestrians on the road.

Gender: Gender was an interesting moderator of reported behaviour yielding different relationships across the three outcome behaviours. Males were more likely to engage in unsafe crossing than females and less planned protective behaviour in rural schools only. There was no gender difference observed for dangerous play. These relationships may be impacted by the observed gender difference in frequency of ‘accompanied by’ prior to running the HLM, with males more likely to be out around the roads on their own and females more likely to be accompanied by adults. There were no gender differences observed for frequency of being out with friends. For unsafe crossing, by Model 6, males were more likely than females to participate in unsafe crossing, however, the only remaining significant ‘accompanied by’ predictor was the frequency of being out around the roads on their own. In this sample, females were less likely than males to be out on the roads on their own on a frequent basis. Similarly, females were more likely to engage more planned protective behaviour than males. However, by Model 6 only the frequency of being accompanied by adults remained significant with the frequency of being out on their own or in the company of friends were not. Females were more likely to be accompanied by adults than males. Finally, for dangerous play, there were no observed gender difference from they were first introduced in the model. By Model 6, the only ‘accompanied by’ predictor to be significant was the frequency of being out with friends. Interesting, there was no significant gender differences in the frequency of being accompanied by friends. While there were no observed cross level interactions observed between gender and these variables for any of the reported behaviours, it still may warrant further investigation in the future.

Accompanied by friends: The higher frequency of being accompanied by friends was more likely to result in more unsafe crossing, more dangerous play and less planned protective behaviour (until the final model). While the relationship with planned protective behaviour weakened when the cross-level interactions were included, it should still be considered as a strong predictor due to the impact of distraction (unsafe crossing) and peer influence (dangerous play).

Accompanied by adults: This was an interesting finding as it demonstrated that being out around the roads more frequently with adults is a positive predictor of more planned protective behaviour and less unsafe crossing and less dangerous play.

Out on the roads on their own: This was a strong positive predictor of unsafe crossing and remained a negative predictor of planned protective behaviour until Model 6. It was a non-significant predictor of dangerous play at any stage of the modelling process.

Exposure: Exposure was not a significant predictor of unsafe crossing; however, it was a positive predictor of planned protective behaviour. It was non-significant on its own in dangerous play, but there was a significant interaction between location and exposure where children with higher levels of exposure in an urban setting demonstrated more dangerous play.

Section 4.4.7 Discussion on The Three Models

Based on the series of HLM models a series of predictors on unsafe crossing, dangerous play and planned protective behaviour have highlighted some interesting results. As a lot of the behavioural differences in terms of gender, age and location have been already discussed in reference to the literature, more focus will be placed here on interpreting the new variables and how or if they interact with the demographic variables already explored.

Unsafe crossing: Overall, the final model (Model 6) provided the most sense theoretically, At Level 1, males were more likely to report unsafe crossing, the negative impact of greater frequency of being on the roads on their own in urban school locations, the experience of a near miss on the road in both urban and rural school settings and finally, higher responsibility beliefs resulted in less dangerous play on the road.

Consistent with the ANOVA results on unsafe crossing, males were more likely to report unsafe crossing in this analysis. Also, the negative impact of being out on the roads more frequently on their own in urban areas helps to clarifies this, as it was reasoned earlier greater exposure to traffic in this sample in the urban area may be driving this higher level of risky or unsafe crossing. While we extrapolated from the higher observed instances of near misses in the urban and rural areas that this was also a potential factor, perhaps more evident in the urban schools, it was clear that it was a very strong predictor in both locations. In fact, the experience of a near miss had the largest observed beta and makes sense as 11 to 12 year olds who are persistently crossing the road in an unsafe manner are more likely to experience at least one if not many near miss events. It can also be explained theoretically that they continue to behave in this manner, despite near misses with traffic, potentially due to unrealistic optimism that they are skilled enough to avoid more serious negative consequences and do not fully appreciate potential hazards due to distraction and cognitive ability.

There was an observed interaction where higher responsibility beliefs resulted in lower unsafe crossing for females only. This is a new variable not considered in the previous modelling which is based around the personal sense of control and responsibility on the road and suggests in this sample, that females may have a more realistic perception about their safety behaviour. This again may be influenced by their greater rule compliance and socialisation to take less risks than males. Further, Morrongiello and Rennie (1998) identified three characteristics of individuals that differentiated risk takers and avoiders with over 80% accuracy. These factors included appraisal of danger, beliefs about personal vulnerability for injury, and attributions for injury (self, other, and bad luck). Children who rated the danger as high, perceived themselves as personally vulnerable for injury in the situation, and anticipated that injury would be attributable to their own behaviour, were more likely to avoid risk-taking. In contrast, those who rated danger and perceived vulnerability as low and who anticipated that injury would not be attributable to their own behaviour, more often endorsed risk-taking.

This is a similar finding to Elliott and Baughan (2004) who used this scale originally and found it to be the strongest predictor of unsafe crossing. It was also interesting to note that in Twisk et al. (2015) psychological determinants were associated with a higher frequency of risk behaviours. In that study, the psychological components included feelings of responsibility for one’s actions, attitudes toward carelessness on the road and opinions on traffic rules. This is an interesting finding and may point in this study more to personal attitudes towards responsibility and heightened risk taking (Dual Systems Theory; Steinberg et al. 2008) rather than experience with traffic as predictors of unsafe crossing. While the final model did not find being accompanied by friends or adults as significant predictors, they were consistent predictors up to and including Model 5. In Elliott and Baughan’s (2004) study, they also found that frequency of being out with friends and alone were significant predictors of higher unsafe crossing and being in the company of adults reducing unsafe crossing. Therefore, while the combined exposure for being out on foot, on a bicycle and scooter/skateboard was not a significant predictor, the frequency of being out in the presence of friends and on their own could be a potential cause for unsafe crossing due to peer influence and distraction.

According to the dual systems perspective, risk taking is elevated between the ages of 10 and 14 years, when the cognitive-control network is undergoing significant developmental change. According to Steinberg's dual-systems theory, peer presence increases activation of socio-emotional networks, resulting in increased risk-taking behaviour (Shulman et al., 2016; Steinberg, 2010). Similarly, Babu et al. (2011) found that 10- to 12-year-olds who rode with a risky peer were more likely to cross intermediate-sized gaps than children who rode with a safe peer. Pfeffer & Hunter (2013) found that participants more frequently identified dangerous road-crossing sites when accompanied by a positive peer, but least often when accompanied by a negative peer. Also, both cautious and unsafe comments from a peer influenced adolescent pedestrians' decisions. With reference to the Theory of Planned Behaviour, a study by Rosenbloom (2012) compared the actual and perceived social norms regarding road crossing behaviours in a sample of 6- to 13-year-olds. Results indicated that the variables, perceived peers' attitudes and perceived peers' behaviours, contributed significantly to the outcome. The riskier the perceived peers' attitudes and behaviours with regard to road crossing, the riskier the child's own behaviour was when crossing the road. Similarly, Morrongiello et al. (2019) study assessed if children aged 8 to 10 perception of peers' behavioural norms for crossing streets related to their personal norms for doing so and if children's self-reports about crossing relates to their actual crossing in a virtual traffic situation. Children's perception of peers' behavioural norms for crossing related to their personal norms for doing so, and their norms related to their reports of how they have crossed in the past few weeks. When crossing virtual streets, children with higher scores on self-reports about risky crossing behaviours selected smaller (riskier) inter-vehicle gap sizes to cross into, showed less start delay (less time appraising traffic before starting), and experienced more hits. Therefore, children's perception of peers' behavioural norms for crossing are relevant to their crossing behaviours and may elevate children's risk when using the roads.

The impact of a peer can also have a distracting effect. Deluka-Tibljas et al.'s (2021) observational study at signalized crossings on children aged 5 to 15 found that social interaction such as walking in pairs or in a group slows down young pedestrians when walking across streets, thereby making their crossing more dangerous. This could result in a near miss or having to run across the road to get across safely. When children are on their own, they may well be distracted by mobile phone use and as self-reported, 'forget to look properly because they were thinking about something else'.

Therefore, while earlier in the ANOVA model where the impact of friends was not assessed, it was considered that the unsafe crossing in males may just be attributed to greater exposure, lack of awareness of their poor hazard perception and deficits in attentional capacity combined with unrealistic optimism that they are skilled enough to avoid more serious negative consequences. However, it may be more complex than that and be a reflection of their elevated risk taking, both on their own and in particular in the presence of peers and perpetuated through the lack of negative consequences and unrealistic optimism.

There is an opportunity for parents to have a positive impact on their children's unsafe crossing in this age groups, as being accompanied frequently by an adult had a positive impact on lowering reported unsafe crossing. According to the research, adult supervision is considered a key behavioural technique for reducing child pedestrian involvement in collisions (Holm et al. 2018). Unfortunately, when parents or adults were observed in the presence of children, few actually provided any instruction when crossing with their children (Morrongiello, & Barton, 2009; O'Neal, 2018; Zeedyk & Kelly, 2003). This is a missed opportunity to guide their children's safe road use behaviour. For example, Thompson et al, (2005) constructed a training programme delivered by mothers that addressed the conceptual and strategic issues involved in learning to cross through traffic gaps. Trained children crossed more quickly, and their estimated crossing times became better aligned with actual crossing times. They crossed more promptly, missed fewer safe opportunities to cross, accepted smaller traffic gaps without increasing the number of risky crossings, and showed better conceptual understanding of the factors to be considered when making crossing judgments. This was a strong indication of children's ability to learn from experience and the importance of enlisting parents as role models and capitalises on the strengths of the peer collaboration method with adult input in improving children's roadside visual search (Tolmie et al., 1998; Tolmie et al., 2000). Similarly, O Neal et al. (2021) examined parental scaffolding of children's prospective control over decisions and actions during a joint perception-action task. The results found that guidance and control shifted from the parent to the child with increases in child age. With younger children, parents more often chose the gap that was crossed and prospectively discussed the gap choice. Greater use of an anticipatory gap selection strategy by parents predicted more precise timing of entry into the gap by children. Finally, Holm et al. (2018) suggested the most important role models for adolescents in traffic behaviour are their parents as they found the role model behaviour with the strongest effect on adolescent high-risk behaviour in traffic is the role model not using pedestrian crossings to cross the street. This is providing older children learn the skill of crossing when no pedestrian crossings are available. Therefore, to effectively act as a role model, parents can start with younger children by holding their hands and discussing their movements and crossing decisions. This can be followed by more independent instruction and discussion as they get older. However, as children get older, parents are less likely to engage in supervision as Tabibi, et al. (2012) found that 11-year-old children often walk alone in traffic because parents have confidence in their ability to be more independent and evaluate risks. Morrongiello and Barton (2009) found the majority of parents thought children are usually capable of crossing streets alone around ages 7–9. However, this expectation may be overly optimistic. Barton and Schwebel (2007) found that children take more risks alone than with parents, while Evans and Norman (2003) reported that 72% of pedestrian accidents involving children occur at a time when they are alone in traffic. Inevitably, young adolescents do not walk on streets only with parents as they did in childhood but also with siblings, friends, teachers, other adults, and alone. Therefore, it is necessary to provide them with age-appropriate education on how to cross safely.

There was an unexpected outcome where children who had experienced RSA education programmes in their school, reported more unsafe crossing up to Model 5 when responsibility beliefs were included and rendered it a non-significant predictor. As responsibility beliefs were a much stronger predictor, this weakened the observed relationship in the previous modes. Further analysis indicated a significant interaction between location and education, where education was associated with greater unsafe crossing in urban schools only. According to the results, location was a stronger predictor than education in Model 6. Therefore, it would appear that it is the powerful force of living in an urban area rather than education per se that is underlying this relationship. Based on the final model interactions and the strongest predictors across each iteration, it is considered that unsafe crossing is more negatively impacted by their gender, the urban environment in which they attend school, live and socialise and strength of responsibility beliefs, rather than education in primary school. Key areas which are very important to highlight are the strong predictive ability of previous near miss experiences, the positive impact of higher responsibility beliefs and if these can be strengthened more, and the higher frequency of being around roads with adults reducing unsafe crossing.

Planned Protective Behaviour:

Overall, the final model provided the most sense theoretically as it retained the strongest predictors that were observed across each model, being a female pedestrian, the positive impact of higher levels of exposure to the road environment, the positive impact of being accompanied by an adult and the positive impact of holding higher responsibility beliefs. Zeedyk and Kelly (2003) suggested exposure develops an awareness of traffic and learning fundamental road safety practices, initially under adult supervision, leading to independent travel. They also noted that adults were more likely to hold girls' hands than boys' hands when being supervised and suggested the gender of the child was a more influential factor than age of child. The authors suggested that adults perceive girls as being more in need of protection and than boys.

In this sample, the female children who reported more planned protective behaviour were also more frequently accompanied by an adult. Also in this sample, females were statistically more likely than males to be accompanied by an adult. Therefore, there is a possibility that the resultant gender difference may be due to the stronger impact of parental guidance and directions on safety for girls over males. As suggested earlier, Morrongiello and Dawber (2004) indicated that girls complied much more than boys with maternal requests to avoid approaching a dangerous object and the perception of parental norms about risk-taking were considered much more by girls than boys. Therefore, they may be more eager or willing to take on board the appeals for protective behaviour to appease their parents' concerns. The higher responsibility beliefs were also an indicator of more planned protective behaviour. As discussed, Morrongiello and Rennie (1998) provided empirical support for this where children who rated the danger as high, perceived themselves as personally vulnerable for injury in the situation, and anticipated that injury would be attributable to their own behaviour were more likely to avoid risk-taking. This may also cause them to engage in more planned protective behaviour.

Negative predictors included an experience of a near miss on the road which was more likely to predict less planned protective behaviour. This, as noted earlier is quite logical, as previous behaviour is a strong predictor of future behaviour according to the Theory of Planned Behaviour: Past behaviour may have a moderating effect on variables within the TPB such as attitude or perceived control. It may be that a higher level of past behaviour could lead to less cognitively demanding inputs thereby impacting PBC. Haque et al. (2012) included perceived risk, anticipated regret, and past behaviour in an extended version of the TPB to predict young people's drink walking intentions. The extended TPB explained an additional 6% of the variance compared to the standard model. Therefore, greater past experiences of near misses may predict less planned protective behaviour due to higher risk taking while using the road.

The location of the school indicated that those in rural schools, in particular females, were more likely to engage in PPB. This may be again driven by the higher proportion of females in rural schools (58%) compared to males (42%). Therefore, combined with the more frequent accompaniment by adults in the female population this may indicate there were more females in the rural population, with higher levels of adult accompaniment, providing more opportunity for planned protective behaviour to be reported than for males in urban settings. Therefore, in this study, planned protective behaviour on the road was more impacted by the environment in which they attend school and live, the level and type of accompaniment (negative with friends, positive with adults) and having stronger responsibility beliefs, rather than education at primary school level.

Dangerous play:

Overall, the final model (Model 6) captured the strongest predictors that were observed across each model. Gender was a non-significant predictor from first inclusion in Model 2 (consistent with the ANOVA analysis) but the variables that remained constant across each iteration until the final model, were the impact of higher levels of exposure to the road environment, the negative impact of greater frequency of being on the roads or with friends and the positive impact of being accompanied by an adult, an experience of a near miss on the road was likely to predict more dangerous play on the road, while having higher responsibility beliefs resulted in less dangerous play on the road. The location of the school indicated that that children in urban schools with higher levels of exposure demonstrated significantly higher levels of dangerous play on the road. Those children with higher levels of responsibility beliefs demonstrated lower levels of dangerous play on the road in urban areas than those in rural locations.

These results are very similar to what was observed in the unsafe crossing behaviour, with the exception of the stronger impact of being around the roads with friends rather than being alone. This would make sense theoretically as play would normally involve more than one person. However, there is a consistently strong message across each of the behaviours and that is the urban location which results in higher risk-taking actives due to the amount of time they spend on the road travelling to and from school and socialising. The main difference here theoretically between unsafe crossing and dangerous play would be the perceived difference in intentionality with these behaviours rather than being lapses or errors. However, as noted previously, the items that contribute to dangerous play in this sample related more frequently to socialising around the roads and the resultant distraction associated with that, rather than primarily high-risk actives such as playing chicken or running across the road for a dare as in other studies with older adolescents included.

In the unsafe crossing model, it was considered that many of the instances underlying unsafe crossing may be a result of their distraction by being accompanied by friends, mobile phone use, thinking about other things while crossing, combined with higher risk taking due to the Dual Systems Theory. While those are still relevant arguments here, as two of the items do centre around socialising with friends and not observing the traffic as a result, there is a much stronger indication on the influence of peers and also how living in an area with a high volume of traffic, most likely in urban areas in an estate or cul-de-sac, has resulted in their lowering of perceived risk and treating the road like an extension of their garden or similar safe recreational area. This is evident in the other questions in the scale, the frequency of running around in the road, rising a scooter, skateboard or roller skates on the road and walking in the road rather than on the footpath. When children are out in larger groups, the impact of peers has been demonstrated to be a negative influence and can increase their risk-taking activities. However, these children are indicating what may be perceived as less risky activities and merely using the available open space for them to socialise. It makes sense that there will be insufficient room for a group of friends to walk together on a foot path and instead use the road, particularly in an estate. They may also be told not to ride scooters or use skateboards on footpaths and with the lack of social amenities such as designated skateboard areas, where else will they engage in these activities. There are generally green areas for children but the lowering in their perceived risk to the traffic in their local area may provide them with a false sense of security due to familiarity with the urban traffic. This lowering of risk has been suggested in other studies involving older adolescent and adult pedestrians maintained that a higher-risk environment influences risk perceptions where the risk becomes "invisible", lowering their perception of risk (Elliott & Baughan, 2004; Glik et al., 1991). This may also relate to the parents' perception of lower perception of risk and messages to these children on the perceived safety of playing independently on the roads in a higher density urban area. Therefore, while the actual activity brings real risk, the perception of its being risky may not be translated in the types of play being engaged in.

This could also be supported by the finding that children with higher levels of responsibility beliefs demonstrated lower levels of dangerous play on the road in urban areas than those in rural locations. Children who perceive that they are in control of their behaviour and that their actions may have consequences and do not perceive that it is primarily the responsibility of other people to keep them safe while on the road have adjusted their level of play accordingly. They may have a higher sense of the actual risk that these activities incur. The difference between the urban and rural location is most likely again being driven by the very powerful influence of the urban location which has habituated the children to traffic and provided them with more opportunity to play on roads.

The lack of gender being a significant predictor also provides weight to this argument as there was no significant difference in the amount of time both males and females were out around the road with friends. Therefore, this type of dangerous play and the same amount of time both genders are socialising around the roads in urban areas with their friends may have resulted in this finding. Once again, the positive impact of an adult lowering the amount of dangerous play reported on the road indicates the powerful effect of parents as role models for their children.

As with unsafe crossing, some of the models where children who had experienced RSA education programmes in their school, reported more dangerous play on the roads. Consistent with dangerous crossing, there was a significant interaction demonstrated where education was only a significant predictor of dangerous play in urban schools only. Education failed to reach significance in Model 5 once responsibility beliefs were included, as in unsafe crossing. Therefore, in this population, it is suggested again that the strength of the urban location as a predictor is driving the observed relationship between education and dangerous play. Separate to this final model, experience of a near miss interacted with levels of exposure indicating that exposure was only a significant predictor of dangerous play when recording a near miss experience. Therefore, it is clear in this study, dangerous play on the road is more impacted by the urban environment in which they attend school, live and socialise and their responsibility beliefs than education at primary school level.

Overall, across each of the behaviours assessed, living in an urban area has a significant impact in the higher levels of unsafe crossing and dangerous play with lower levels of planned protective behaviour due to the impact of greater frequency of being out around the roads either on their own or with friends. They are in the age group where they have a higher propensity to take risks than younger children (Dual Systems Theory), have had previous experience with near miss events in traffic but this would appear to have strengthened their perception of safety in their behaviour due to lack of what they perceive as negative consequences. They have become habituated to the presence of traffic and are highly susceptible to both peer influence and distraction putting them at even greater risk. However, there are two very powerful areas which can have a positive impact on their behaviour, the presence of an adult or parent as a role model for good road safety behaviour and having strong responsibility beliefs. It could be as a result of education in schools but that is not very clear from these results. They could possibly be attributed to an individual's developing internal locus of control or be as a result of a family climate of road safety where they are constantly observing and internalising good road safety practice. The observed higher responsibility beliefs in the female population may be again as a result on differences in how males and females are socialised towards risk taking. It may well be a combination of all. However, in the absence of a definite answer in this study, it is suggested as an important avenue for further exploration to provide families with better road safety messages to impower their children to use the road safely.

Chapter 5 Parent and Child Risk Perception and Pedestrian Behaviour

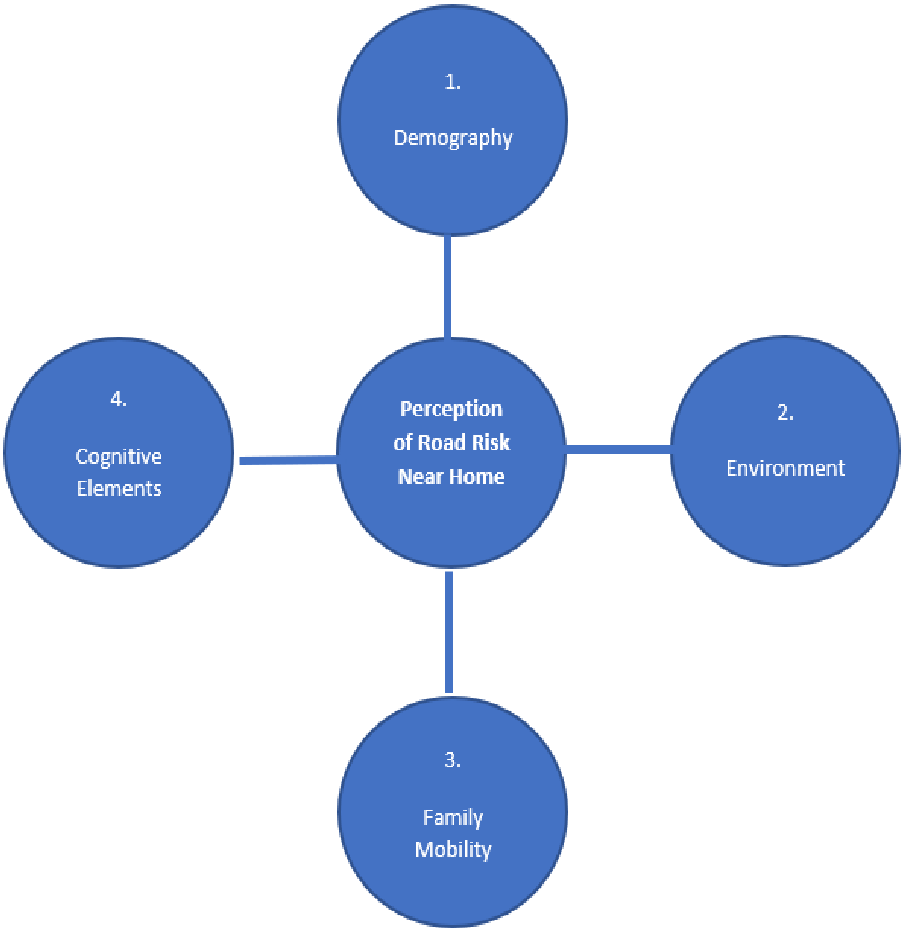
This chapter analyses the self-reported behaviour of 125 matched pairs of parent and child with a view to assessing some of the factors that influence risk perceptions within the parent-child dyad. The study (Study 2 as per methodology) was also designed to enable an investigation into the degree to which self-reported behaviour by the children correspond to the self-reported behaviour of parents while in the company of their children and their rating of how they expect their children behave when using the road. More details on how the study was conducted can be found in Chapter 2, Methodology, Section 2.2. The questions on road use were extracted from the ARBQ (Elliott & Baughan, 2004) and were classified as 'unsafe crossing' and 'planned protective behaviour'. It is appreciated that the items in the unsafe crossing scale may not necessarily be considered 'risky' to adults who have a greater degree of skill and perceptual ability to cross the road. However, for the sake of consistency in reporting when making the comparisons between the children and adult behaviour, this term will be used throughout the study. Dangerous play was excluded from this study as it was not relevant to adults. The assessment of risk was based on an extended conceptual framework first put forward by Cloutier et al. (2011), Figure 5.1.

According to Cloutier et al. (2011) the perception of risk is in fact an individual's subjective interpretation of a potentially dangerous situation based on the information that a person has. In their research they presented a model reflecting the influences on the perception of road risks in the school context, using four main themes: demography, environment, family mobility, and cognitive elements. They used these themes as the basis for the development and exploration of different variables recognised in the literature for their influence on certain risk perceptions. A review of these variables can be found in Section 1.3.8.

However, while the original model focused on the perception of risk on roads around the school, this study examined the risk perception of road safety around the home. Research has indicated that child pedestrian collisions mostly occur on neighbourhood roads and local streets near home (Ha and Thill, 2011; Gris´e et al., 2018). It is predominantly the case in Ireland that urban and rural children attend primary school, either within walking distance from their home or within a very short commute due to strict catchment areas, making the school setting a neighbourhood location.

Figure 5.1

Conceptual Framework of Risk Perception (Cloutier et al., 2011)



There have been amendments made to the content under each of the four themes to better reflect the aims of this study, while maintaining the integrity of the overarching theme. There is an extension of the model to include behavioural elements, not included in the original model but based on the results of Study 1 which demonstrated the powerful impact of past behaviour.

Section 5.1 Variables included in the Analysis

Demographic Variables: The data collected in this section will be used to determine the background information of the respondents and to assess the influence of these individual variables on risk perception. Variables relate to both the parent (age, gender, level of education, number of children) and child (age, gender, birth order).

Environment Variables: Rating of traffic volume in residential setting by both parent and child.

Mobility Variables: The main transport to school each day: walking, cycling, bus or car. The frequency of the parents walking for work or pleasure and the frequency of the child walking around either a) country roads, or b) urban areas in the accompaniment of adults, friends or on their own.

Cognitive Process Variables: These included perceived safety rating for the traffic around their home (parent and child), the rating parents assigned to five potential sources of danger to their child might be exposed to (serious falls, molestation, abduction, road traffic collision and severe diseases). Parents also rated their perceived ability to reduce risks while walking on country roads or urban areas and the parents' rating of their child's capability to cross the road independently. Finally, the child's reported road safety responsibility beliefs and their experience of a road traffic collision (RTC) either themselves or a close friend/family member in the previous 5 years (parent and child).

Behaviour Variables: Two additional variables were included based on past behaviour which may have an impact on how people perceive future risks on the road. Both parent and child's self-reported rating of unsafe crossing was collected. If a person has a history of more risky road crossing, with or without negative consequences, it can lead them to either increase their risk perception or lower it due to the lack of negative consequences. Children were also asked to identify how frequently they have experienced a near miss episode on the road.

The Dependent variable: The measurement of risk in this study is the same as used by Cloutier et al. (2011) which was based on work by Lam (2001; 2005). It involves 8 scenarios portraying risk situations for children on or close to a street (see Section 2.2 for more details).

Section 5.2 Parent Demographic and Reported Pedestrian Behaviour

Section 5.2.1 Parent Demographic

Age and Gender: Of the 125 parents who completed the survey, 90 (72%) were female and 35(28%) were males. The average age was 41.6 years. Table 5.1 sets out the age by gender, with males being on average older.

Table 5.1

Age and Gender of Parent

	N	Mean	SD	Min	Max
Female	90	41	4.2	34	49
Male	35	43.4	5.4	36	52

Table 5.2 sets out the proportion of males and females with second or third level education, with almost three times as many having third level education.

Table 5.2

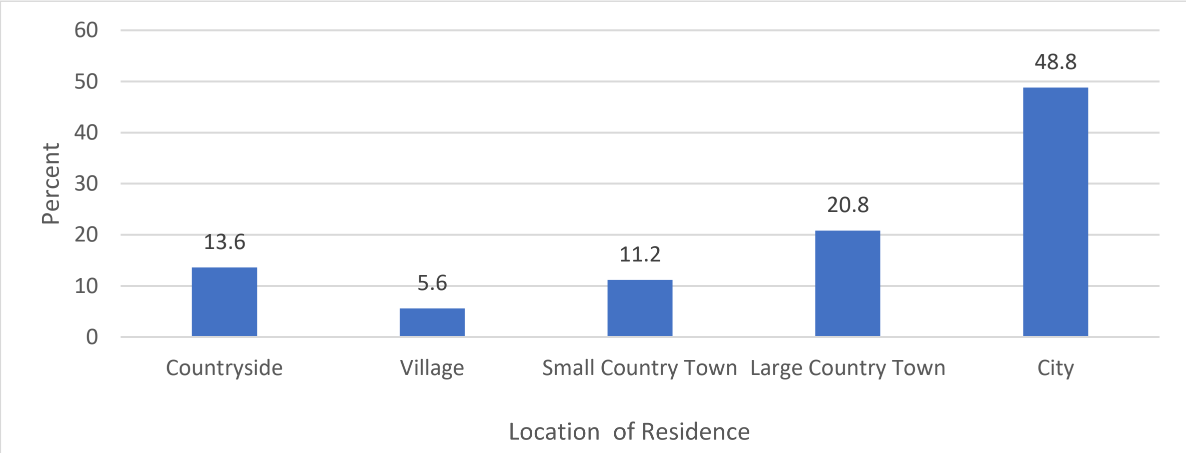
Age and Education of Parent

	Female		Male		Total	
	N	%	N	%	N	%
Secondary	35	38.9	8	22.9	43	34.4
Third Level	26	28.9	9	25.7	35	28.0
Postgraduate	29	32.2	18	51.4	47	37.6
Total	90	100.0	35	100.0	125	100.0

Location resides: Almost half (48.8%) of the sample resided in a city, while only 14% lived in the countryside (Figure 5.2). This may be the first indication of parent’s perception of road safety and pedestrian risk as a greater concern for those who live in an urban location rather than a countryside location where their children are necessarily exposed more to the traffic on a daily basis. Learning to safely navigate the urban traffic in the location they live is essential for their safety. Twelve of those who indicated they lived in the countryside lived on a small country road (local road, not national) and 5 lived on a lane.

Figure 5.2

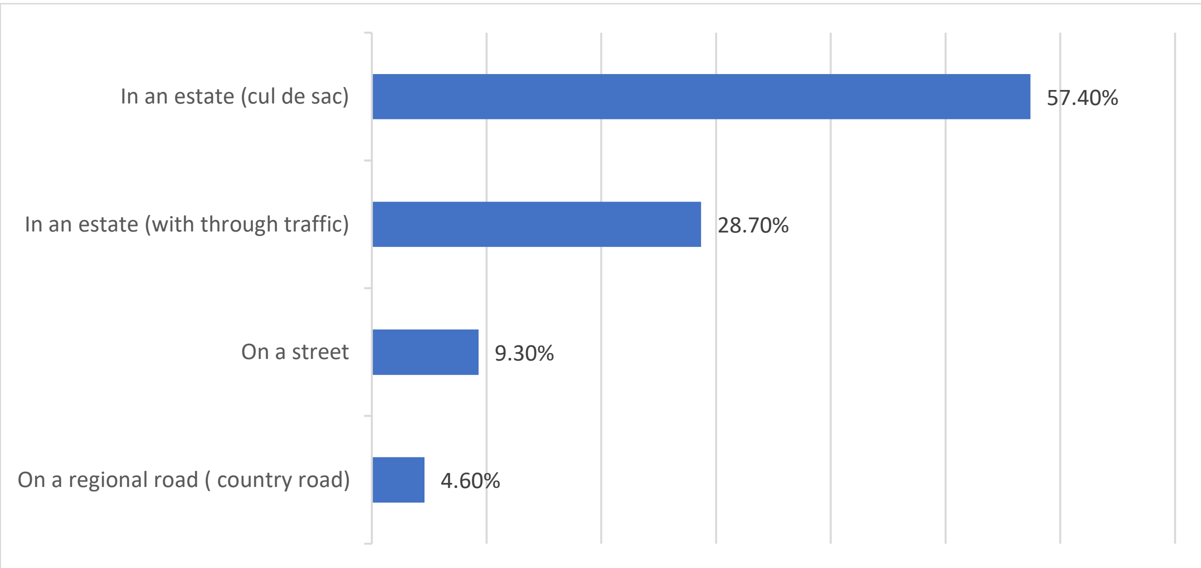
Residential Location of Parent and Child



Over half (57%) of those who indicated they lived in a village, town or city resided in a cul-de-sac with no through traffic (Figure 5.3).

Figure 5.3

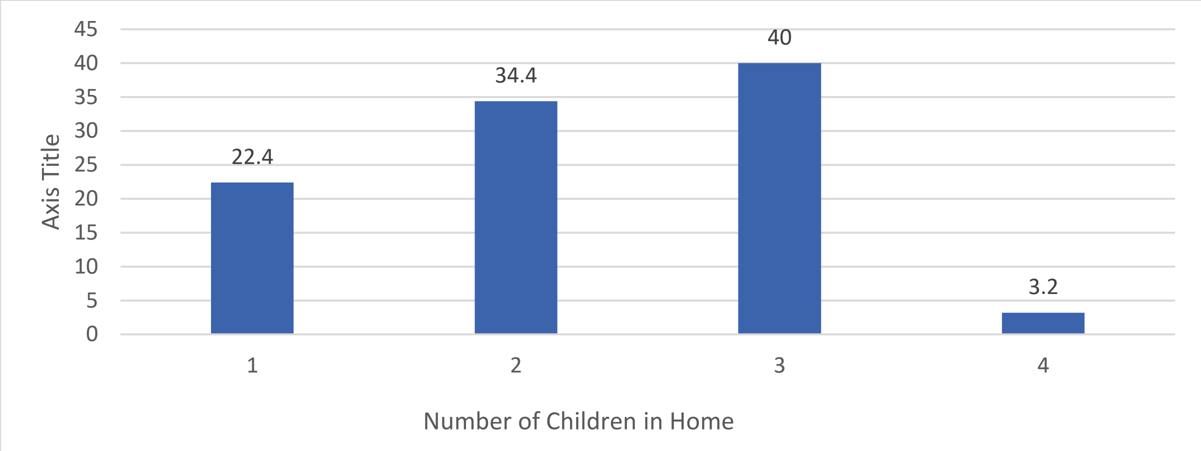
Location of Residence in Urban Area



Only 3% of the sample had four children in their home (Figure 5.4) with a fairly even distribution of 2 and 3 child families.

Figure 5.4

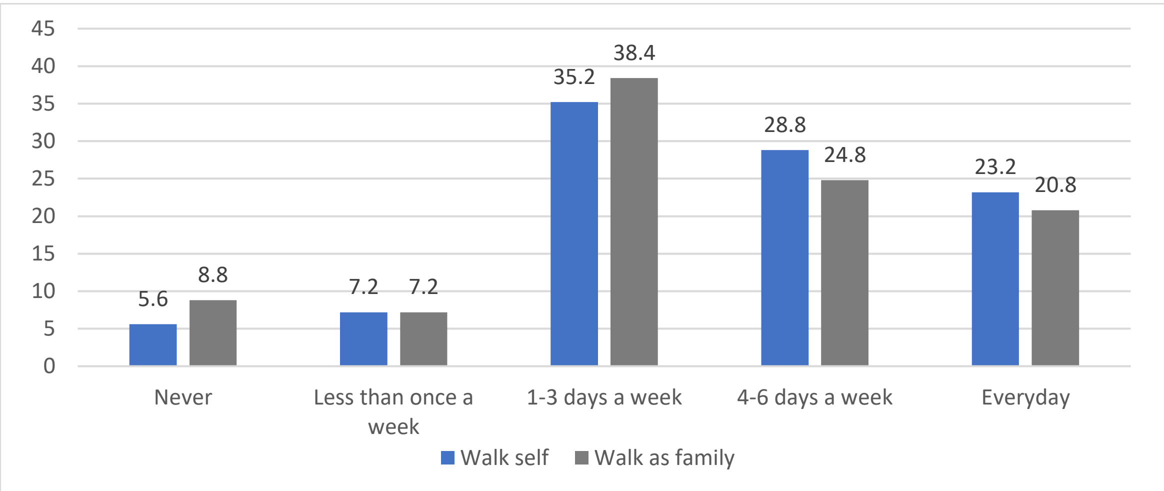
Number of Children in the Home



Frequency of walking: Parents were asked how often they walked themselves for pleasure/fitness/to work and secondly, how often they walked as a family for pleasure/fitness/school. Figure 5.5 illustrates a very similar pattern which may indicate that children are walked to school before continuing on to work. It also indicates over half of the parental sample walk between 4 and 7 days a week.

Figure 5.5

Frequency of Walking on own or as a Family for Pleasure, Work and School



History of RTC: Parents were asked to indicate if they or a family member had experienced an RTC in the previous 5 years. If they had, they were asked the level of seriousness from ‘minor- no overnight stay’, ‘serious – at least one overnight stay’ or in the case of family or friends, ‘fatal’. Finally, they were asked what mode of transport was involved including, pedestrian, cyclist, passenger or driver. Of the 125 who responded, 36 (29%) had experienced an RTC themselves and 89 (71%) had not. Of the 36, 27(75%) were rated as minor with no overnight stay and nine (25%) required at least one overnight stay. The Level of seriousness by mode of transport is set out in Table 3, with most collisions experienced as a driver.

There was a higher number of reported collisions involving a friend or family member. Fifty-seven (46%) said a family or friend had been involved in a collision with 68 (54%) saying no. Of the 57, only seven stated they were serious requiring at least one overnight stay in hospital. The number and type of collision is set out in Table 5.3.

Table 5.3

Number of Serious and Minor Collisions by Type

	Self		Family/Friend	
	Minor	Serious	Minor	Serious
Pedestrian	5	0	20	0
Cyclist	7	4	2	2
Driver	15	1	28	3
Passenger	0	4	0	2
Total	27	9	50	7

Demographic summary for parents:

Almost three times more of the parents who responded were female with an overall sample age range of 34 to 49 years. More of the parents had attended third level education (61%). Three quarters of the sample indicated they had either 2 or 3 children in their home. Less than fifteen percent lived in a countryside setting with over half of those who indicated they lived in an urban location, living in a cul-de-sac, followed by an estate with a through road. This has an implication for their children due to their immediate environment for socialising and attending school. There were high levels of exposure as over half of the parents indicated they walked for either pleasure, work or school between 4 and 7 days a week. There was an experience either themselves or a family member of being involved in a pedestrian RTC, although none required overnight stay. Therefore, this sample is reflective of an urban family with high levels of exposure to traffic.

Section 5.2.2 Parent Reported Pedestrian Behaviour

Parents were asked how often they performed the road crossing behaviours set out in Table 5.4 while in the company of their children. They rated the behaviour from 'Never to Very Often' on a 5-point Likert scale. These questions were a sample of road crossing question from the 41 item ARBQ (Elliott & Baughan, 2004). While this pedestrian survey was validated for the 11- to 18-year-old population, it was selected for the parents to complete as the results will be compared with that of their children who are aged between 11 and 12 years. The items were selected based on two categories, 'Unsafe Crossing' and 'Planned Protective Behaviour'. This research was interested in assessing the impact of the demographic variables gender, age and education on self-reported parental 'Unsafe Crossing' and 'Planned Protective Behaviour'. Two three-way ANOVAs were used to determine if there was an interaction effect between the variables (gender, education and location) on the dependent variables 'Unsafe Crossing' and 'Planned Protective Behaviour'. All main effects and interactions were examined along with effect sizes as recommended by Cortina and Nouri (2000). All significant main effects with three or more levels were explored post hoc using Tukey HSD. Investigation of significant interactions will employ an analysis of simple effects along with visual inspection to guide the process.

Section 5.2.2.1 Unsafe crossing

The items for unsafe crossing are rated on a 5-point scale from low (never) to high (Very Often), therefore, higher means indicate less desirable road use behaviour. As can be seen in Table 5.4, the parents are displaying some less desirable road crossing when in the presence of their children such as not bothering to walk to a nearby crossing and misjudging the speed of oncoming traffic. This has implications for modelling good pedestrian behaviour when in the company of children as discussed in Chapter 1, children aged between 11 and 12 years do not have the same perceptual ability to assess gaps in traffic (Chihak et al., 2010; Plumert & Kearney, 2018), thereby, if attempting this type of behaviour demonstrated by parents on their own, without a parent present, it may result in their having a near miss or having to turn back to avoid traffic. Parental modelling of good road safety practice to this age group can be a perceived as a challenge as this age group are more likely in an urban setting to walk independently to school and socialise with friends. This leaves less opportunity for parents to model safe pedestrian behaviour. However, children do walk on streets with their parents outside of school hours making these occasions an ideal time to help influence children's pedestrian practices. To support this, research (Morroginello et al., 2008) has indicated that children mostly model their own behaviour on parents' behaviour rather than their words and in particular, the older the children get, the more they copy their parents' behaviour. They also notice more when parental safety practices are discrepant from what they are being taught. Their research compared the impact of parent practices and teaching about safety on children's current behaviours and their intended future behaviours when they reach adulthood and found children aged 7 to 12 years current behaviour was best predicted by parental teaching. However, how children planned to behave when they were adults was best predicted by parents' practices. Therefore, these results highlight the strength of family influences on children's adoption of safety and risk practices and support the notion of parental involvement in active road safety education. According to Holm et al. (2018) supervision is considered a key behavioural technique for reducing child pedestrian involvement in collisions and the type of supervision and modelling will necessarily change according to the age of the child. Morrongiello and Barton (2007) found that parents of younger children hold hands (direct physical contact) to help them restrain a child who may behave impulsively. However, they noted supervision can be tailored for use with older children such as discussing how to cross the road safely and offer guidance in their absence. The literature support this assertion that older children can benefit from this parental guidance as Thomson et al, (2005) training program with enlisted a group of mothers of children aged 7, 9 and 11 found trained children crossed more quickly, and their estimated crossing times became better aligned with actual crossing times. They crossed more promptly, missed fewer safe opportunities to cross, accepted smaller traffic gaps without increasing the number of risky crossings, and showed better conceptual understanding of the factors to be considered when making crossing judgments. All age groups improved to the same extent, and there was no deterioration when children were retested 8 months later. This was a strong indication of children's ability to learn from experience and that importance of enlisting parents as role models and capitalises on the strengths of the peer collaboration method with adults in improving children's roadside visual search (Tolmie et al., 1998; Tolmie, Thomson, & Foot, 2000). More recent research by O' Neal et al. (2021) examined parental scaffolding of children's prospective control over decisions and actions during a joint perception-action task. Parents and their 6-, 8-, 10-, and 12-year-old children (N = 128) repeatedly crossed a virtual roadway together. The results found that guidance and control shifted from the parent to the child with increases in child age. With younger children, parents more often chose the gap that was crossed and prospectively discussed the gap choice. Greater use of an anticipatory gap selection strategy by parents predicted more precise timing of entry into the gap by children. This supports the efficacy of parents starting their children's road safety education at an earlier stage and continuing to support their children's development and skill for navigating complex road crossing situations through the latter part of primary school (even if they are using the road independently) through modelling good road safety behaviour and active education.

Table 5.4

Mean and SD of Parents Reported Unsafe Crossing when with Children

Item	M	SD	Min	Max
Not bother walking to a nearby crossing to cross the road?	3.7	1.0	2	5
Have to stop quickly or turn back to avoid traffic?	3.4	1.4	1	5
Think it is OK to cross safely, but a car is coming faster than you thought?	2.9	1.3	1	5
Get part way across the road and then have to run the rest of the way to avoid traffic?	2.7	1.2	1	4
See a small gap in the traffic and "go for it"?	2.6	1.1	1	5
Cross whether traffic is coming or not, think the traffic should stop for you?	2.2	1.3	1	5
Cross from between parked cars when there is a safer place to cross nearby?	2.1	1.2	1	5
Run across a road without looking because you are in a hurry?	1.5	0.6	1	3
Forget to look properly because you are talking to people/child(ren) who are with you?	1.3	0.6	1	3
Use a mobile phone and forget to look properly?	1.3	0.5	1	3

A composite scale was created called ‘Unsafe Crossing’ based on the 10 items from the ARBQ in Table 5.4. to provide the behavioural variable that will be used in the prediction of risk behaviour. In order to get a better understanding of what factors may impact this behaviour in the parent group such as the gender of the parent, their level of education and age, a Three Way ANOVA was conducted. To facilitate the ANOVA analysis, age was broken into three age-bands (34-39, 40-45, 46-52). Education was also split into a binary variable as it will also be used in the regression analysis in the subsequent section. It was deemed suitable to collapse into the two levels based on second level and third level education to make interpretation of the results simpler.

Prior to the analysis an investigation of the normality indicated the KS test was significant, D (125) = .11, however, the level of skew (.34) and kurtosis (-.99) fell within the lower accepted range (-/+ 1). Therefore, combined with a visual inspection of the histogram, this scale approximated a normal distribution and was deemed suitable for ANOVA. Table 5.5 sets out the full results of the ANOVA analysis for parent unsafe crossing by demographic variables.

Table 5.5

ANOVA Parents' Reported Unsafe Crossing

	Sum of Squares	*df*	*F*	*p*	η_p^2
Gender	557.48	1	42.40	<.001	0.27
Education	4.36	1	0.33	0.57	0.00
Age-band	23.13	2	0.88	0.42	0.02
Gender * Education	0.83	1	0.06	0.80	0.00
Gender * Age-band	121.08	2	4.60	0.01	0.08
Education* Age-band	0.03	2	0.00	1.00	0.00
Gender * Education * Age-band	20.83	1	1.58	0.21	0.01

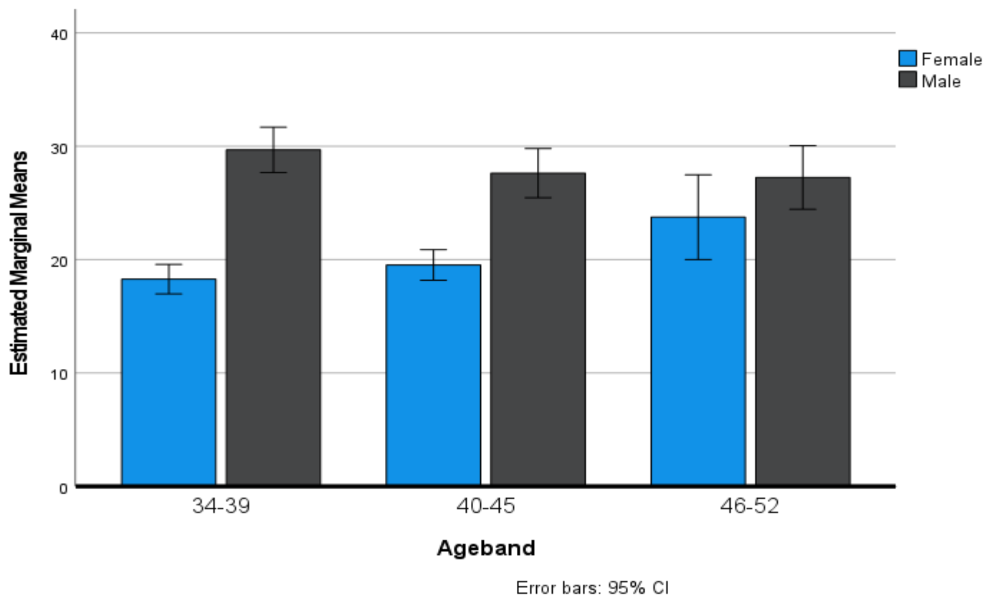
The result of the Levenes test indicated the variance between the groups were not equal, F (9,114) = 9.92, $p < .001$. Therefore, the more stringent alpha of .01 was set to interpret any main effects or interactions. Higher mean scores represent more unsafe crossing.

There was a main effect for gender, *F* (1,114) = 42.39, *p* < .001, η_p^2= .27 indicating a large effect size. There was no main effect of education, *F* (1,114) = .33, *p* = .57, or age, *F* (2,114) = .88, *p* = .42. However, there was a significant interaction between age and gender rendering the main effect of gender redundant; *F* (2,114) = 4.6, *p* = .01.

Analysis of simple effects indicated that males (*M* = 29.69, *SD* = 1.09) reported higher unsafe crossing than females (*M* = 18.28, *SD* = .66) in the 34-39 age group, *F* (1,114) = 89.95, *p* < .001, η_p^2 = .44. In the 40 -45-year-old age group, males (*M* = 27.63, *SD* = 1.09) also reported higher unsafe crossing than females (*M* = 19.53, *SD* = .68). There were no gender differences in the 46- to 52-year-old age group. Only females demonstrated significantly different behaviour across each age band, in this instance, increasing slightly with age, *F*(2,14) = 4.01, *p* = .02. Figure 5.6 below depicts the interaction between age and gender.

Figure 5. 6

Interaction between Parent Age and Gender Unsafe Crossing



Section 5.2.2.2 Planned Protective Behaviour

The items which fall under planned protective behaviour are scored on a 5-point Likert scale from low (never) to high (Very Often), therefore, high scores indicate more positive road use behaviour. While there was very high compliance observed for looking both ways before crossing, the mean for making sure that the traffic has stopped before using the pedestrian crossing could be higher. As this is a very important life lesson for children to learn, this is a missed opportunity to model good behaviour as discussed in Section 5.2.2.1. Further, children who receive RSA education programmes are consistently delivered the message to never cross at a controlled crossing until they are sure that the traffic has stopped. In these programmes children are informed that cars may not always stop at a crossing for reasons such as distraction or lack of consideration for the rules of the road and pedestrian safety. Therefore, not only is this a behaviour modelling poor road safety behaviour and in effect placing the pedestrians safety at the hands of the driver, it is providing contradictory guidance to children at a very vulnerable age. The mean for use of reflective clothing and walking facing the traffic and in single file on roads with no footpath were lower than expected. This may be reflective of the urban location where the opportunity for walking on roads with no footpath is limited and the presence of streetlights may have impacted people's perception of safety around the use of reflective clothing in urban areas (Table 5.6). However, an examination of the parents who live in a countryside location demonstrated low means for use of reflective clothing (M = 1.29 SD =.47), walking facing the traffic (M = 3.14, SD = .51) and walking in single file (M = 1.27, SD =.46). Therefore, these results overall indicate either a lack of knowledge of the rules of the road or a willingness to discard the advice to facilitate walking on roads with no footpaths.

Table 5.6

Mean and SD of Parents' Reported Planned Protective Behaviour when with Children

Item	Min	Max	M	SD
Look both ways before crossing?	1	5	4.8	0.7
Check to make sure the traffic has completely stopped before you cross at a pedestrian crossing?	1	5	3.2	1.4
Walk in the road facing the traffic when on roads with no footpaths? (Right side of road)?	1	5	3.1	1.4
Walk in single file on roads without a footpath?	1	5	2.3	1.4
Wear reflective clothing when walking on roads?	1	5	1.9	1.2

A composite scale was created called 'planned protective behaviour' based on the 5 items from the ARBQ in Table 6.6. Prior to the analysis an investigation of the normality indicated the KS test was significant, *D* (125) = .17, however, the level of skew (-.37) and kurtosis (-.53) fell within the lower accepted range (-/+ 1). Therefore, combined with a visual inspection of the histogram this scale approximated a normal distribution and deemed suitable or ANOVA.

The result of the Levenes test indicated the variance between the groups were not equal, F (9,114) = 18.33, p < .001. Therefore, the more stringent alpha of .01 was set to interpret any main effects or interactions. Higher mean scores represent planned protective behaviour. The results for the ANOVA analysis is set out in Table 5.7.

Table 5.7

ANOVA Parent Planned Protective Behaviour

	Sum of Squares	*df*	*F*	*p*	η_p^2
Gender	39.01	1	8.11	0.01	0.07
Education	8.02	1	1.67	0.20	0.01
Age-band	36.92	2	3.84	0.02	0.06
Gender * Education	0.83	1	0.07	0.79	0.00
Gender * Age-band	112.16	2	11.66	<.001	0.17
Education* Age-band	35.69	2	3.71	0.03	0.06
Gender * Education * Age-band	2.89	1	0.60	0.44	0.01

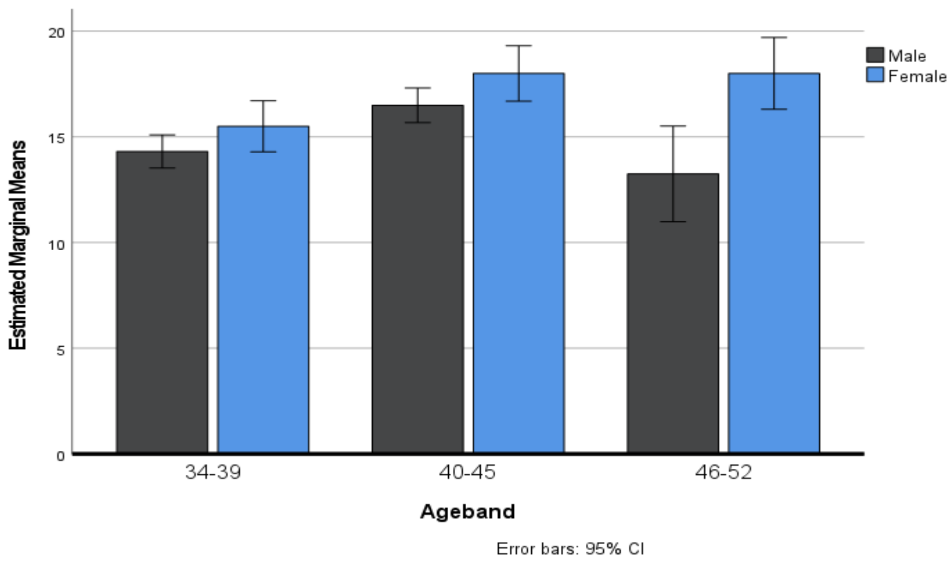
- alpha set at .01

There was a main effect for gender, F (1,114) = 8.11, p = .01, η_p^2= .07 indicating a small effect size. There was no main effect of education, F (1,114) = 1.67, p = .20, or age, F (2,114) = .3.84, p = .02 (alpha set at .01). However, there was a significant interaction between age and gender; F (1,114) = 11.08, p <.001 with a larger than anticipated effect size based on the effects for both on their own (Figure 5.7). Analysis of simple effects indicated that females (*M* = 18.8, *SD* = 0.86) reported higher planned protective behaviour than males (*M* = 13.2, *SD* = 1.14) in the 46-to-52-year age group. There were no gender differences in the 34-39 and 40 to 45 age groups. Both males and females demonstrated significantly different behaviour across each age band, in this instance, females increasing slightly with age, F(2,14) = 8.85, p <

.001 whereas males decreased planned protective behaviour in the 46 to 52 age group, f(2,114) =4.48, p =.01.

Figure 5.7

Interaction between Parent Age and Gender on Unsafe Crossing



Section 5.2.3 Predicting Parent Unsafe Crossing

To assess the impact of a predefined set of variables (outlined in Section 5.2) on parents reported unsafe crossing, a Hierarchical linear regression was conducted. The data was assessed to ensure there were no violations of the assumption of normality, linearity, homoscedasticity and independence of residuals.

All predictor variables included in the regression are set out in Table 5.8. Further explanation on each of these variables can be found in Section 5.2. While age and education were found not to be significant in the ANOVA analysis, it was decided to retain these variables in the regression as the age can be entered in continuous form rather than in a categorical age-band which may have masked some important variation as the interaction between both age and gender was significant. Some of the Likert variables have been collapsed into two levels to reduce the complexity of the variables entered into the regression while still maintaining the integrity of the variable:

- Safety of Environment: Collapsed from 5 levels to 2 levels from 'very safe', 'pretty safe', 'nether safe or unsafe', 'a little unsafe' and 'very unsafe' to 'Safe' and 'Unsafe'. This was reduced due to the level of extreme rating at either end of the scale.
- Control Urban: Collapsed from 'strongly agree', 'agree', 'neither agree or disagree', 'disagree', 'strongly disagree' to 'Agree' and 'Disagree', due to the extreme scoring on either end of the Likert scale. Only urban control was entered due to the low number of people who reside in the country and to reflect the majority urban population in this sample.

Table 5. 8

Predictor Variables Name, Type and Coding

Name	Type	Coding
Parent Age	Continuous	
Parent Gender	Binary	0 = Male
		1 = Female
Education	Binary	0 = Secondary Level
		1 = Third Level
Safety of Environment	Binary	0 = Safe
		1 = Unsafe
Volume of Traffic	Binary	0 = Heavy
		1 = Light
Exposure	Continuous	
History of RTC Self	Binary	0 = No
		1 = Yes
History of RTC Family	Binary	0 = No
		1 = Yes
Control Urban	Binary	0 = Not agree
		1 = Agree
Planned Protective Behaviour	Continuous	

The variables were entered in two blocks with the demographic variables in block one as a control for the cognitive and behavioural variables.

Parent age, gender and education were entered in step 1 explaining 57% of the variance; *F* (3, 121) = 53.73, $p < .001$. Once the attitudinal and behaviour variables were included the variance explained raised to 67%; *F* (10, 114) = 22.59, $p < .001$. This set of variables accounted for an additional 9% of the variance, *R* square change = .93, *F* change (7, 114) =4.35, $p = .002$. In the final model, gender, age, control, history of RTC in previous 5 years and reported planned protective behaviour were significant predictors. An investigation of the semi partial correlations indicated that of these, gender was the strongest predictor (*sr* = -.68, $p < .001$) indicating that females demonstrated significantly lower unsafe crossing than males. Gender accounted for 17% of the total variance on its own, whereas the next highest predictor, age, accounted for only 3.2% of the unique variance. In this analysis, as age increased so did unsafe crossing. However, as noted in the ANOVA analysis, this was due to the females increasing unsafe crossing as they got older. Parents who felt they could control the risks in an urban environment also reported more unsafe crossing, whereas parents who had a personal history of an RTC in the 5 years previous and reported more planned protective behaviour, reported lower unsafe crossing. The full set of predictors can be found in Table 5.9.

Table 5.9

Hierarchical Linear Regression Summary for Predicted Parent Behaviour

Step and Predictor	*B*	*SE B*	*Beta*		*sr*	*Change in R2*	*R2*
Step 1						.57***	.57
(Constant)	18.96	3.35					
Parent gender	-8.62	0.76	-0.70	***	-0.68		
Education	-0.41	0.77	-0.04		-0.03		
Age	0.23	0.08	0.19	***	0.17		
Step 2						.09***	.67
(Constant)	18.28	4.60			3.98		

Parent gender	-8.27	1.08	-0.67	***	-7.64
Education	0.39	0.74	0.03		0.53
Age	0.27	0.08	0.23	***	3.31
Safety of environment	-0.59	1.04	-0.05		-0.57
Volume of traffic	0.24	1.17	0.02		0.20
Control Urban	2.01	0.74	0.17	*	2.70
History of RTC Self	-1.91	0.75	-0.16	**	-2.55
History of RTC Family	0.75	0.76	0.07		0.98
Exposure	0.61	0.35	0.12		1.73
Parent PPB	-0.33	0.12	-0.17	**	-2.76

* P < .05; * * p < .01; *** p < .001

Summary of parents predicted unsafe crossing:

Gender was the strongest predictor of unsafe crossing indicating that females demonstrated significantly lower unsafe crossing than males. This remains consistent with literature and is reflected in the numbers of collisions involving males compared to females.

While age was also a significant predictor it accounted for much less of the variance than gender (3.2%) but indicated that as age increased so did unsafe crossing. The most interesting was that parents who felt they could control the risks in an urban environment also reported more unsafe crossing. It would be expected that if parents felt they could control the risks in an urban environment they would engage in more protective behaviour, however, that was not evident as per Section 5.2.2, where 87% indicated that they frequently do not bother walking to a nearby pedestrian crossing, 59% reported crossing whether traffic coming thinking it should stop for them, 51% reported getting halfway and having to run the rest of the way and 25% indicated they see a gap and go for it. Having a history of an RTC themselves in the previous 5 years reduced their unsafe crossing as did having higher planned protective behaviour.

Section 5.2.4 Discussion on Predicted Parent Unsafe Crossing

Gender was the strongest predictor of unsafe crossing indicating that females demonstrated significantly lower unsafe crossing than males. An extensive amount of literature has found that males engage in more risky behaviours than females (Granié, 2009; Harris et al., 2006; Moyano, 2002; Prato et al., 2012; Rosenbloom et al., 2011). Women's perception of their susceptibility to an accident resulting from an unsafe crossing is higher than that of men; women also report more than men that they are motivated by normative (traffic laws) and instrumental considerations (perceived danger). Previous research on compliance in the adult population has shown that male pedestrians violate more rules than female pedestrians (Moyano Diaz, 2002; Rosenbloom et al., 2004; Yagil, 1998). For example, at crossings, rule compliance is significantly lower among male pedestrians where Yagil (2000) found that men are more likely to cross than women when a 'Don't Cross' signal is displayed and is supported by earlier research by Ferenchack (2016) and Tom and Granie (2011). Male pedestrians shownhigher intentions to perform risky road behaviours, especially younger non-drivers (Holland & Hill, 2007), and males expect fewer negative outcomes of traffic violations than females (Parker et al.,1992)

While age was also a significant predictor it accounted for much less of the variance than gender (3.2%) but indicated that as age increased so did unsafe crossing. This is an interesting result and runs contrary to the literature which has found a negative correlation between age and risky pedestrian behaviour on the road, such that younger pedestrians take more risks and have a higher probability of being in a pedestrian collision than older pedestrians (Dunbar, 2012, Lichenstein et al., 2012). It may be a reflection of the mainly urban location of this sample, where the years of living and crossing streets without negative consequences have reinforced their behaviour as they get older. It may also be an example of increased carelessness due to higher levels of stress or distraction in this cohort aged up to 52 years. Past behaviour is a strong predictor of future behaviour as a meta-analysis on the utility of the Theory of Planned Behaviour by Ouellette and Wood (1998) reported that when a specific behaviour is practiced repeatedly, and the context of performance is stable, past behaviour becomes a better predictor of future behaviour than intention. Several studies have utilised TPB constructs and extended versions, to explain pedestrian behaviour such as risky crossing (Evans & Norman, 2003; Holland & Hill, 2007; Lennon, et al., 2017; Moyano

Díaz, 2002; Zhou et al., 2016; Zhou & Horrey, 2010) intentions to cross while distracted by a mobile phone (Barton at al., 2016) drink walking (Gannon et al., 2014; Haque et al., 2012) intentions to jaywalk (Xu et al., 2013).

The most interesting finding was that parents who felt they could control the risks in an urban environment reported more unsafe crossing. It would be expected that if parents felt they could control the risks in an urban environment they would engage in more protective behaviour, however, their self-reports indicated that they frequently do not bother walking to a nearby pedestrian crossing, reported crossing whether traffic was coming or not thinking it should stop for them, reported getting halfway and having to run the rest of the way and indicated they see a gap and go for it. It has to be noted that adults have fully developed cognitive skills for safe risk-taking, and do not necessarily avoid participating in all risk behaviours, and are better at taking calculated risks (Steinberg, 2008). Therefore, if they have a greater sense of control but are not exercising obvious areas under their control, it is suggested this relationship is based on an over estimation of their own skill at road crossing due to years of no negative consequences. Lam (2001) suggested a strong sense of control is generally expressed when the individual perceives the level of risk to be low.in lower risk perception on the part of this individual in road safety and elsewhere based on the concept that the person concerned thinks he/she can in fact “control” the risk situation. The sense of control has been confirmed many times as a predicator of risk perceptions, either by influencing behavioural intentions or by increasing the optimism bias (or the risk denial) related to perceptions (DeJoy 1989; Fischoff et al, 2000; Sjoberg, 2000; Vlek & Hendrick, 1989, as cited in Cloutier et al. 2011). This could also be supported in the finding that those who had a personal history of an RTC in the 5 years previous and reported more planned protective behaviour reported lower unsafe crossing. Cloutier et al. (2011) suggested cognitive processes have been shown to be linked to risk perceptions including past experiences, sense of control, and personal beliefs. Under social-cognitive theory, negative past experiences increase the perception of risk.

Section 5.3 Parent Attitudes and Perception of Risk

Section 5.3.1 Volume of Traffic and Safety Rating

When asked to rate the volume of traffic around their home, parents in each category rated traffic as heavy, but only some in the city rated the traffic as very heavy (Table 5.10). Similarly, parents were asked to rate how safe or unsafe they felt their traffic environment around their home was (Table 5.11).

Table 5.10

Parents Perception of Volume of Traffic Around Home

		N	%
Countryside	Very light traffic	5	29.4
	Heavy Traffic	12	70.6
Village	Heavy Traffic	7	100
Small Country Town	Light traffic	7	50
	Heavy Traffic	7	50
Large Country Town	Light traffic	11	42.3
	Heavy Traffic	15	57.7
	Total	26	100
City	Very light traffic	8	13.1
	Light traffic	16	26.2
	Heavy Traffic	25	41
	Very heavy traffic	12	19.7

Table 5.11

Parents Rating of Safety of Traffic Around Home

		N	%
Countryside	Pretty safe	5	29.4
	A little unsafe	5	29.4
	Very unsafe	7	41.2
Village	Unsafe	7	100
Small Country Town	A little unsafe	7	50
	Very unsafe	7	50
Large Country Town	Neither safe nor unsafe	6	23.1
	A little unsafe	11	42.3
	Very unsafe	9	34.6
City	Pretty safe	12	19.7
	Neither safe nor unsafe	6	9.8
	A little unsafe	22	36.1
	Very unsafe	21	34.4

As the numbers were too restrictive to run meaningful analysis due to the numbers in each group, an examination of the relationship between the parents rating of the volume of traffic and their perception of the safety was run on the two groups large country town and city. A chi-square test of association was significant; $\chi 2(9) = 94.87$, $p < .001$, Cramer v = .60 indicating a large effect size. An examination of the standardised residuals indicated that those parents who rated the traffic around their home as very light also rated their environment to be pretty safe. On the reverse of this, parents who rated their traffic around their home as very heavy, rated their environment to be very unsafe. This pattern is supported by the literature, where people who live in high traffic areas rate the safety risk as high (as cited in Cloutier et al., 2011)

Section 5.3.2 Perception of Control on Country and Urban locations

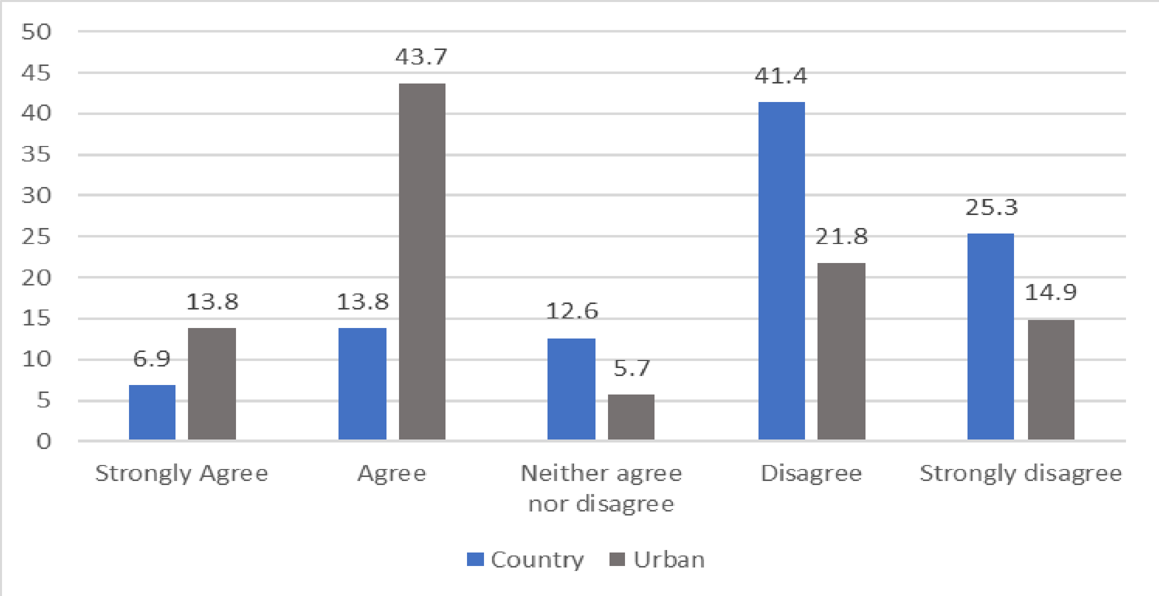
Parent were asked to rate their agreement with the following statements ‘ I can control road risks when walking along a country road’ and ‘ I can control road risks when walking along in an urban area’.

Country roads: It was clear that people felt they had little control on a country road with almost two thirds stating they either disagreed or strongly disagreed with the statement (Figure 5.8). This needs to be interpreted with caution due to the low number of people who reside in a country location as this may lead people who live in towns or cities to overestimate the risk of walking along a country road due to the lack of experience walking on such roads. Interestingly, all of the 17 people who said they reside on the country rated that they disagreed or strongly disagreed with the statement suggesting they felt no control However, when these parents were asked about how often they wear reflective clothing, walk in single file or walk facing the traffic, none performed any of these behaviours. All of the 17 also indicated that they frequently let their children walk in country areas with adults or friends. Each of the three behaviours have the potential to limit the risks for walking on country roads and again, demonstrate either a lack of awareness of these safety measures or a level of disregard for same. Overall, it indicates that in this sample, people are rating a lack of control but are not exercising appropriate control measures. This finding should also be interpreted in light of 10 of the parents rating their traffic environment as safe (Table 5.11).

Urban area: Over half of the parents asked felt they could control the risks in an urban environment. However, thirty seven percent felt they could not. A closer inspection of the responses to unsafe crossing items for parents who responded that they disagreed or strongly disagreed shows that 87% indicated that they frequently do not bother walking to a nearby pedestrian crossing, 59% reported crossing whether traffic coming thinking it should stop for them, 51% reported getting halfway and having to run the rest of the way and 25% indicated they see a gap and go for it. Therefore, these parents are indicating a lack of ability to control their risk in an urban environment, but in many cases are failing to use pedestrian crossings when close by and engaging in otherwise risky road crossing behaviour, thereby putting themselves at unnecessary risk. By comparison, of the 58% who said that they could control the risks, only 28% said they frequently do not bother to walk to a nearby pedestrian crossing, 25% said they never cross whether traffic is coming or not, 30% reported getting part way across the road and none frequently see a gap in the traffic and go for it. Therefore, while these parents sometimes demonstrated less desirable road crossing behaviour, they were exercising more control over their personal risk by using the pedestrian crossings and taking less unnecessary risks in urban traffic. While these numbers are small, they are a good indication of the disconnect between behaviour and perception of control and warrant further investigation.

Figure 5.8

Parents' Perception of Level of Control when Walking in Countryside or Urban Location



Section 5.3.3 Perception of Sources of Danger to their Child

Parents were asked to rate their highest sources of danger from 1 to 5 for their child/children. This question is based on Cloutier et al. (2011). As can be seen in Table 5.12, parents rated road traffic collision as the greatest source of danger to them, indicating a real concern for the safety of their children on the roads.

Table 5.12

Parents Rating of Highest Sources of Danger for Child/Children

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Road Traffic Collision	112	9	0	4	0
Serious Falls	9	68	31	10	7
Molested	4	17	32	44	28
Abduction	0	9	14	3	49
Serious Disease	0	22	48	14	41
Total	125	125	125	125	125

Section 5.3.4 Perception of Child Ability to Cross Road Independently

Parents were asked to rate how capable their child was at crossing the road independently and if they felt that they were unable to do so, to provide explanation on what was their main concern. Over three quarters felt that their child was either very capable or capable (Table 5.13). Of the 15 (12%) who rated their child as not being capable, traffic too heavy and traffic too fast were the reasons cited.

Table 5.13

Parent Rating of Child Ability to Cross Road Independently

Rating	N	%
Very capable	32	25.6
Capable	67	53.6
Somewhat capable	11	8.8
Not at all capable	15	12
Total	125	100

Section 5.3.5 Parents Rating of Age and Method of Teaching Child to Cross Road Independently

When asked to give an age at when they think that a child can cross the road, the average age was 8.7 years (*SD* = 1.87) ranging from 6 to 14 years. Table 5.14 sets out the frequencies of each age suggested. Almost a third of parents suggested that children should be able to independently cross the road as young as 6 years and may be reflective of the urban location and the number of people who live in cul de sacs (*N* =62) and estates (*N* =31). These children are exposed to traffic around their home every day and in many cases may socialise on the estate and play on central green areas. This would require a level of independence in road crossing and navigation of a traffic environment at an earlier age.

Table 5.14

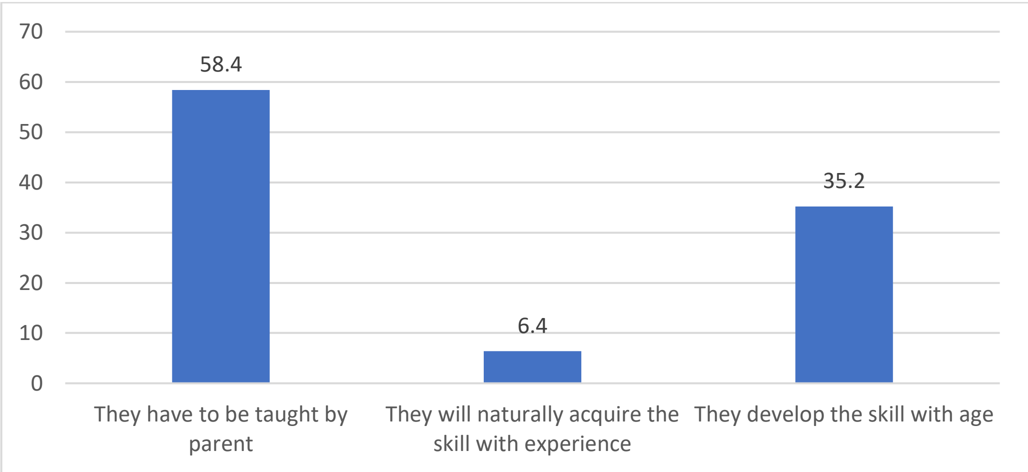
Parents Estimation of Age at Which Can Cross a Road Independently

Age	N	%
6	2	1.6
7	38	30.4
8	26	20.8
9	11	8.8
10	28	22.4
11	5	4.0
12	11	8.8
14	4	3.2
Total	125	100

When asked how children should be taught to cross the road, over half (58.4%) thought they should be taught by a parent with the next biggest proportion indicating that they develop the skill with age (Figure 5.9). Interestingly, the only response that was not selected was having to be taught to cross the road at school.

Figure 5.9

Parents Opinion on How Children Should be Taught to Cross the Road



Section 5.3.6 Perception of Danger for Certain Behaviours

Parents were asked to rate how dangerous they rate the behaviours in Table 16, that their child might engage in. While there were obvious extreme ratings in the direction expected, such as rating 'always' to 'dangerous' for crossing a street without looking, there were some more interesting ratings observed. For instance, higher numbers than anticipated for low rating of danger for playing on footpaths and breaking the red pedestrian light when no cars are coming. While 48% noted that it was often dangerous for their child to cross the road at a place other than a pedestrian crossing, surprisingly, 40% felt it was only sometimes or rarely/never dangerous. These results are interesting in light of the parents rating of their child capability (very capable or capable) to cross the road independently (79%). Therefore, the parents in this sample have a high level of confidence in their children's ability to navigate an urban traffic environment and cross the road safely. This again may be driven by the location of where they live such as cul de sacs and estates and experience of their children's independent road use ability. Table 5.15 sets out the percentage who responded under each category and the mean score for each.

Table 5.15

Rating of Danger for Child Road Safety in Different Circumstances

	Always Dangerous	Often dangerous	Sometimes Dangerous	Rarely Dangerous	Never Dangerous
Crossing the street without looking	65.1	32.3	2.6	0.0	0.0
Playing on a country road.	60.9	32.2	6.9	0.0	0.0
Crossing the street from between parked cars	41.2	32.9	8.7	15.5	1.7
Crossing the street other than at a pedestrian crossing (with and without signal)	11.5	48.3	17.2	12.6	10.3
Playing on the footpath	10.3	18.4	6.9	14.9	49.4
Crossing at a pedestrian crossing without traffic lights.	10.3	41.4	28.7	12.6	6.9
Crossing when the pedestrian light is red and there are no cars coming	10.3	17.2	3.2	33.6	35.7
Crossing when the pedestrian light is green.	2.7	4.2	11.6	37.2	44.3

Section 5.3.7 Predicting Parent Perception of Risk for Child Pedestrian

The aim of this section is to gain a better understanding of the development or predictors of parental risk around their children's pedestrian behaviour. Based on the previous study on which analysis is based (Cloutier et al.,2011) a series of variables were identified as potential predictors for the DV, parental perception of risk for their children. As per the protocol in the original study, this analysis was conducted in two stages. Due to the large volume of variables, a series of t-Tests and One Way ANOVA between each variable and the DV were conducted, and the second step involved the modelling of the significant variables from that analysis using Hierarchical Linear regression. For clarity of reporting the results of the nonsignificant relationships, excluded from the analysis have been presented in Table 5.16.

Table 5.16

Summary of Non-Significant Variables for Parental Perception of Child Pedestrian Risk

Variable	t	DF	P
Source of Danger Rating (0 = Other, 1 = RTC)	0.78	123	0.22
Travel to School (0 = Other, 1 = Walk)	1.74	123	.07
	f		
Education	1.53	2,122	.23
Traffic Volume Rating	0.48	3,121	.69
Child Capability	.80	3,116	.49
Walking Exposure	4.4	4,120	.09

These non-significant results are consistent with Cloutier et al. (2011) with the exception of the source of danger rating which was a significant predictor the original research. Hierarchical multiple linear regression was employed to assess the impact of a series of significant variables on the dependent variable, parent perception of child pedestrian risk. Some of the Likert variables have been collapsed into two levels to reduce the number of overall variables entered into the regression but still maintaining integrity of the variable.

Converted variables are set out below and Table 5.17 sets out the variables name, type and coding.

- Safety of Environment: Collapsed from 5 levels to 2 levels from 'very safe', 'pretty safe', 'nether safe or unsafe', 'a little unsafe' and 'very unsafe' to 'Safe' and 'Unsafe'. This was reduced due to the level of extreme rating at either end of the scale.
- Control Urban: Collapsed from 'strongly agree', 'agree', 'neither agree or disagree', 'disagree', 'strongly disagree' to 'Agree' and 'Disagree', due to the extreme scoring on either end of the Likert scale. Only urban control was entered due to the low number of people who reside in the country and to reflect the majority urban population in this sample.

Table 5.17

Name, Type and Coding of Predictor Variables Parent Perception of Risk

Name	Type	Coding
Parent Age	Continuous	
Parent Gender	Binary	0 = Male
		1 = Female
Safety of Environment	Binary	0 = Safe
		1 = Unsafe
History of RTC Self	Binary	0 = No
		1 = Yes
History of RTC Family	Binary	0 = No
		1 = Yes
Control Urban	Binary	0 = Not agree
		1 = Agree
Child gender	Binary	0 = Male
		1 = Female
Birth Order of Child	Continuous	
Parent Unsafe crossing	Continuous	

Prior to running the hierarchical regression, the data was assessed to ensure there were no violations of the assumption of normality, linearity, homoscedasticity and independence of residuals. The variables were entered in 3 blocks with parent demographic entered in the first block to act as a control.

- Step 1: The demographic variables parent, gender and age were added in step 1, explaining 36% of the total variance in parent perception of risk, F (2,119) = 32.32, p < .001.
- Step2: After adding the safety of the environment, self and family of an RTC, child gender, child's birth order and urban control rating, at step 2, the total variance explained raised to 56%, after controlling for the demographic variables; F (8,111) = 17.95, p < .001. The addition these variables raised the variance explained by 20%, R square change =.20, F Change (6,111) = 8.83, p < .001.
- Step 3: The variables relating parents unsafe crossing raised the variance to 61%, F (9,110) =19.00, p < .001. These variables increased the overall variance by 4%, R square change =.04, F Change (1,110) = 12.48, p < .001. The full summary of this regression model can be seen in Table 5.18.

The strongest predictor was having a family member in an RTC in the 5 years previous increasing risk and accounting for 6.5% of the variance. The next strongest was parent unsafe crossing which increased risk and accounted for 4.5% of the variance. The parent gender was the next strongest, where females had a higher risk perception, accounting for 4.3% of the variance, the child's gender increased risk with perception higher if the child is female accounting for 3.8% of the variance. Rating the area they lived as unsafe heightened risk and accounted for 3% of the variance. Finally, a personal history of an RTC also increased the risk accounting for 2.7% of the variance.

Table 5.18

Hierarchical Multiple Regression Summary for Parental Perception of Child Pedestrian Risk

	B	*SE*	*Beta*	*p*	*sr*	*Change* R^2	R^2
Step 1						.36***	.36
(Constant)	14.2	3.2					
Parent Gender	6.3	0.8	0.6	***	0.58		
Parent Age	0.0	0.1	0.0		-0.01		
Step 2						.20***	.56
(Constant)	7.6	4.5					
Parent Gender	5.8	0.8	0.6	***	0.46		
Parent Age	0.0	0.1	0.0		-0.02		
Safety of Environment	2.3	0.8	0.2	***	0.18		
History of RTC Self	1.9	0.8	0.2	***	0.15		
History of Family RTC	3.7	0.8	0.4	***	0.28		
Child Gender	1.5	0.8	0.2	***	0.12		
Child Birth Order	0.5	0.4	0.1		0.09		
Urban Control Rating	-0.6	0.8	-0.1		-0.05		
Step 3						.04***	.61
(Constant)	2.6	4.6					
Parent Gender	3.3	1.0	0.3	***	0.20		
Parent Age	0.0	0.1	0.0		-0.03		
Safety of Environment	2.1	0.7	0.2	***	0.17		
History of RTC Self	2.0	0.7	0.2	***	0.17		
History of Family RTC	3.5	0.8	0.4	***	0.26		
Child Gender	2.9	0.8	0.3	***	0.21		
Childs Birth Order	0.4	0.4	0.1		0.07		
Urban Control Rating	-1.0	0.7	-0.1		-0.08		
Parent Unsafe Crossing	0.3	0.1	0.4	***	0.21		

*** $p < .001$

Summary of the Regression:

Overall, these results indicate a consistency with what is demonstrated in the literature. Females demonstrated higher road safety risk consistent with the literature which previously investigated child road safety risk perception. Having a higher risk rating for the safety of traffic in the area was also significantly increased the perception of risk. The gender of the child was a significant predictor, with parents of female children rating road risks as higher than for males. Parents who had a family history of an RTC or experienced an RTC in the past 5 years themselves also rated the risk for their children higher. Finally, previous higher unsafe crossing also increased the perception of road risk for their children.

Section 5.3.8 Discussion on Predictor of Parent Risk for Child Pedestrian

Overall, these results are consistent with published literature. Females demonstrated higher road safety risk e.g., Sellstrom et al. (2000) suggested women in general, and mothers in particular, have higher risk perceptions, while Lam (2001) found that fathers had lower risk perceptions than mothers. Yagil (2000) found womens perception of their susceptibility to an accident resulting from an unsafe crossing is higher than that of men; women also report more than men that they are motivated by normative (traffic laws) and instrumental considerations (perceived danger). Having a higher risk rating for the safety of traffic was supported by Harris and Miller (2000) who demonstrated that mothers are more likely to have higher concerns about traffic volume, which in turn reduced the likelihood that their children walk or cycle to school. Apart from gender, there is a strong link in the literature for higher traffic risk ratings in the local area to greater perceived risk associated with children walking to school or socialising independently. Rothman et al. (2015) investigated parents' perceptions of traffic danger along the school route and at the school site, and between perceptions of high levels of school route traffic danger, and social and built environment variables. The odds of frequent walking to school were 47% lower with high perceived school route traffic danger, but walking was unrelated to perceived school site traffic danger. Gielen et al. (2004) claim that a high-risk environment fosters high risk perceptions, at least in less affluent neighbourhoods. This is supported by previous research indicating that concerned parents are less likely to let their children walk to and/or from school (Carver et al., 2010; Kerr et al., 2006; McMillan, 2007; Rundmo & Nordfjærn, 2013). Christie et al. (2007) investigated parents of children aged 9–14 years living in lower socioeconomic areas and found the key sources of risk identified by parents in their area were illegal riding and driving around estates and, on the pavements, the speed and volume of traffic, illegal parking, drivers being poorly informed about where children play and their own children's risk-taking behaviour. Therefore, living in neighbourhoods with less traffic and a higher walkability can reduce parental concerns (Lam 2001; Kerr et al. 2006; Napier et al. 2011). As this sample was predominantly urban and the majority lived in estates or cul-de-sacs, high density of traffic is always going to be a concern.

Another source that increased parental perception of risk was the gender of the child with parents of female children rating road risks as higher than for males. This has been indicated in the literature where Zeedyk and Kelly (2003) found adults were more likely to hold girls' hands than boys' hands. It appears that the gender of the child was a more influential factor than age of child. The authors suggested that adults perceive girls as being more in need of protection and control than boys. Of course, this may also just be a reflection that boys will not allow parents to hold hands while walking. However, it may still perpetuate the notion that girls are more vulnerable in traffic than males and follow on from social psychological theory, where girls are socialised to be wary of risks whereas boys are socialised to be undaunted by potential risks (Harris & Miller, 2000). A study by Pfeffer et al. (2010) investigated adult pedestrian behaviour when accompanying boys and girls in primary schools up to the age of nine years. The results found that adults behaved more cautiously when accompanying girls compared to boys. Damashek et al. (2013) found that younger child age, child gender (female), higher levels of injury risk behaviour, and higher perceived risk of injury by mothers resulted in higher reported levels of supervision. This has implications on how female children are socialised for risk taking and may have an impact on their future safe road crossing.

Consistent with previous research, parents who had a family history of an RTC rated the risk for their children higher. Cloutier et al. (2011) suggested cognitive processes have been shown to be linked to risk perceptions including past experiences, sense of control, and personal beliefs. Under social-cognitive theory, negative past experiences increase the perception of risk and Cloutier et al. (2011) also implicated the role of personal beliefs. These beliefs are considered to have an impact on risk perception as according to research this affect or feeling of "fear" or "dread" to danger increase risk perceptions (Finucane et al.2000;

Greening et al.2005; Rundmo & Nordfjærn, 2013; Slovic & Peters, 2006). Therefore, knowing someone who was close to you experienced an RTC either minor, serious or fatal, may increase your perception of fear, thereby increasing the perception of risk to this happening to someone close to you. As discussed in Section 1.3, this perception of fear can have negative impacts on crossing the road due to unnecessary hesitancy.

It is interesting, that while having experience of an RTC themselves in the previous 5 years was a predictor, the family history accounted for more variance in the model. It was not possible to ascertain whether this was driven by its being their own child, as when asked only two of the children indicated that they themselves had been involved in a collision (one pedestrian, one cycling, both minor). Finally, higher past unsafe road crossing behaviour was the second strongest predictor indicating the power of previous experience. These parents are recognising the risky behaviour they themselves experience and which in turn leads to a perception of higher risk for their children. The results from the unsafe crossing section indicated that those who had a higher sense of control in an urban area, also demonstrated higher levels of unsafe crossing. While these questions were designed for children rather than adults with greater skill and expertise in road crossing, it does still suggest that they are prepared to take more risks as they feel they can control it. Therefore, this may be a form of cognitive dissonance, as the experience of having a previous RTC has increased their risk perception but are still behaving the same while crossing.

Interestingly, Lam (2000) found that parents of families that had experienced an accident had significantly lower risk perceptions than other parents. Lam suggested a strong sense of control is generally expressed in lower risk perception on the part of this individual in road safety and elsewhere based on the concept that the person concerned thinks he/she can in fact “control” the risk situation. The sense of control has been confirmed many times as a predicator of risk perceptions, either by influencing behavioural intentions or by increasing the optimism bias (or the risk denial) related to perceptions (DeJoy 1989; Fischoff et al, 2000; Sjoberg, 2000; Vlek & Hendrick, 1989, as cited in Cloutier et al. 2011).Therefore, perhaps this helps to explain why the perception risk rating was more substantially impacted by its happening to a family or friend, rather than themselves due to their own perceived sense of control.

Section 5.4 Child Demographic and Reported Pedestrian Behaviour

Section 5.4.1 Child Demographic

The gender breakdown of the children who responded is fairly even, however, the majority of the males were 12 years old compared to the majority of females being aged 11 (Table 5.19).

Table 5.19

Age and Gender of Children

Age	Male		Female		Total	
	N	%	N	%	N	%
11	4	7.50	48	66.70	52	41.60
12	49	92.50	24	33.30	73	58.40
Total	53	100.0	72	100.0	125	100.0

The children who responded to the survey were in the majority either the first or second born in their family (Table 5.20). Birth order was a predictor of parental perception of risk (Cloutier et al, 2011).

Table 5.20

Birth Order of Child

	N	%
First born	57	45.6
Second born	48	38.4
Third born	13	10.4
Fourth born	7	5.6
Total	125	100

When asked, the parents responded to how frequently they allowed their child to be out around the roads either with an adult, friends or on their own. To reflect the different traffic environments and where they may live, they were asked to classify this by country roads and an urban setting like a town or city. Unsurprisingly, given the majority of the responses came from urban dwellers, there was not a lot of frequent exposure in the company of adults, friends or on their own on country roads (Table 5.21). Similar to the previous study involving 1,100 children, females were more likely to be out in the company of adults.

Interestingly, and consistent with the research in Study 1 with the sample of 1, 100 children, males were once again observed to be out less in the company of adults and more often out with friends and in particular on their own. This is pointing to a greater level of exposure to traffic and independence in the young male population compared to the females (Table 5.22).

Table 5.21

Frequency of Being Out on Country Roads

	Males		Females	
With Adults	N	%	N	%
Never	38	71.7	10	13.9
Less than once a week	5	9.4	31	43.1
1-3 times a week	10	18.9	5	6.9
4-6 days a week	0	0	14	19.4
Everyday	0	0	12	16.7
Total	53	100	72	100
With Friends				
Never	49	92.5	44	61.1
Less than once a week	0	0	9	12.5
1-3 times a week	4	7.5	5	6.9
4-6 days a week	0	0	7	9.7
Everyday	0	0	7	9.7
Total	53	100	72	100
On their Own				
Never	45	84.9	39	54.2
Less than once a week	0	0	4	5.6
1-3 times a week	8	15.1	22	30.6
4-6 days a week	0	0	0	0
Everyday	0	0	7	9.7
Total	**53**	**100**	**72**	**100**

Table 5.22

Frequency of Being Out in Town/City

	Males		Females	
With Adults	N	%	N	%
Never	0	0.00	0	0
Less than once a week	22	41.5	5	6.9
1-3 times a week	19	35.8	24	33.3
4-6 days a week	8	15.1	20	27.8
Everyday	4	7.56	23	31.9
Total	53	100.0	72	100.0
With Friends				
Never	0	0	5	6.9
Less than once a week	0	0	31	43.1
1-3 times a week	17	32.1	6	8.3
4-6 days a week	9	17	17	23.6
Everyday	27	50.9	13	18.1
Total	53	100	72	100
On their Own				
Never	0	0	0	0
Less than once a week	0	0	12	16.7
1-3 times a week	10	18.9	35	48.6
4-6 days a week	18	34	18	25
Everyday	25	47.2	7	9.7
Total	53	100	72	100

Section 5.4.2 Child Reported Pedestrian Behaviour

Section 5.4.2.1 Near-Miss

Based on the finding in Study 1, that a very high proportion of children have reported experiencing near miss events, it was included as a variable in this study to act as an additional predictor for their unsafe crossing. Children were asked to rate how often they may have experienced a near miss on the road ranging from ‘Never’ to ‘Very often’. A review of the frequencies highlights some risky behaviour. As can be seen in Table 5.23, over a third (35%) stated they ‘hardly ever’ experienced a near miss. However, when combined with those who reported ‘sometimes’ and ‘fairly often’, 81% self-reported at least one incident of a near miss. A chi-square test of independence was performed to examine the relationship between gender and the self-reporting of a ‘near miss’ on the road. The relationship between these variables was significant, X^2 (3, N = 125) = 20.20, $p < .001$, Cramer’s V = .40. An examination of the standardised residuals indicate that males were less likely than females to report having 'hardly ever' experienced a near-miss and only males indicated that they have fairly often experienced a near miss however, the effect size was moderate.

Table 5.23

Number and Percentage of Near-Miss by Gender

	Male		Female		Total	
	N	%	N	%	N	%
Never	6.00	11.32	17.00	23.61	23.00	18.40
Hardly ever	13.00	24.53	31.00	43.06	44.00	35.20
Sometimes	24.00	45.28	24.00	33.33	48.00	38.40
Fairly Often	10.00	18.87	0.00	0.00	10.00	8.00
Very Often	0.00	0.00	0.00	0.00	0.00	0.00
Total	53.00	100.00	72.00	100.00	125.00	100.00

Section 5.4.2.2 Unsafe Crossing

The children were asked to rate how frequently they performed behaviours under the category of 'Unsafe Crossing' and 'Planned Protective Behaviour'. Table 5.24 sets out the means for unsafe crossing indicating a higher level of risk than expected in this age group when crossing the road. This may in part be explained by the large urban sample in this study, the higher proportion of males in the 12-year-old age group and the greater frequency of males being out around urban areas on their own and with friends than females. In Study 1, in Chapter 4, it was noted that children in urban settings have higher reported unsafe crossing. It should also be noted that males were also more likely to perform more unsafe crossing and be out more frequently on their own which resulted in higher reporting of unsafe crossing. Therefore, these results are consistent with the research presented in Chapter 4, strengthening the observation of the urban environment and gender providing a challenge to child pedestrian road safety.

Table 5.24

Children's Unsafe Crossing Means and Standard Deviations

	M	*SD*	*Min*	*Max*
Have to stop quickly or turn back to avoid traffic?	3.59	0.29	1	5
Forget to look properly because you are talking to people/child(ren) who are with you?	3.14	1.50	1	5
Not bother walking to a nearby crossing to cross the road?	3.12	0.86	1	4
Run across a road without looking because you are in a hurry	2.86	1.02	1	4
Think it is OK to cross safely, but a car is coming faster than you thought	2.75	0.85	1	3
See a small gap in the traffic and "go for it"?	2.72	1.10	1	5
Cross from between parked cars when there is a safer place to cross nearby	2.69	0.81	1	5
Use a mobile phone and forget to look properly?	2.62	0.97	1	5
Get part way across the road and then have to run the rest of the way to avoid traffic	2.62	0.69	1	3
Cross whether traffic is coming or not, think the traffic should stop for you	1.89	0.89	1	4

A Two-way ANOVA was used to determine if there was an interaction effect between the variables (gender and education) on the dependent variables 'Unsafe Crossing' and 'Planned Protective Behaviour'. Due to the low response in some of the categories of location it was not possible to conduct a three-way ANOVA with location included as it would have required the exclusion of the country population from the full analysis. All main effects and interactions were examined along with effect sizes as recommended by Cortina and Nouri (2000). All significant main effects with three or more levels will be explored post hoc using Tukey HSD. Investigation of significant interactions will employ an analysis of simple effects along with visual inspection to guide the process.

A composite scale was created called 'Unsafe Crossing' based on the 10 items from the ARBQ in Table 5.25. Prior to the analysis an investigation of the normality indicated the KS test was significant, D (125) = .17, however, the level of skew (-.59) and kurtosis (.13) fell within the lower accepted range (-/+ 1). Therefore, combined with a visual inspection of the histogram this scale approximated a normal distribution and deemed suitable for ANOVA.

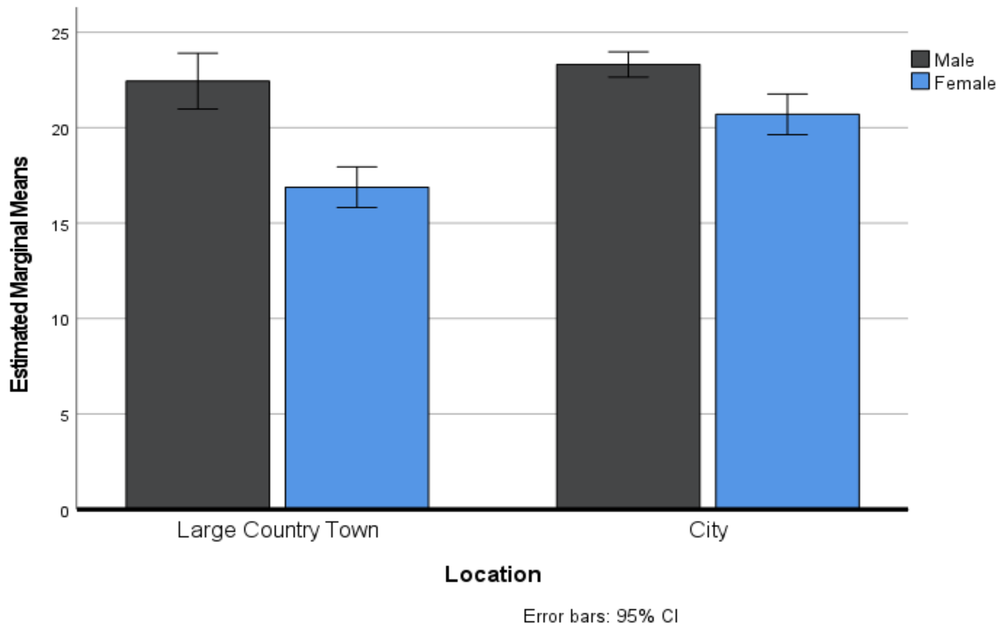
The result of the Levenes test indicated the variance between the groups were not equal, F (3,121) = 5.20, p =.002. Therefore, the more stringent alpha of .01 was set to interpret any main effects or interactions. Higher mean scores represent more unsafe crossing. There was a main effect for gender, *F* (1,121) = 29.63, *p* < .001, η_p^2= ·20 indicating a large effect size. Males (*M* = 23.17, *SD* = 1.73) reported higher unsafe crossing than females (*M* = 19.47, *SD* = 2.9). There was no main effect of age *F* (1,121) = .73, *p* = .393. Therefore, we reject the null hypothesis for H1 and accept the null hypothesis for H2 and H3.

As there were no males in the country, village or small town, a Two Way ANOVA was run to assess the impact of gender and urban location on unsafe crossing as this may help to interpret the findings of the higher means in the sample. A two-way ANOVA was run on gender (males and females) and location (large town and city). As the Levenes test was significant; *F* (3,83) = 15.47, *p* < .001, a more stringent alpha of .01 was set to interpret main effects and interactions.

There was a significant main effect of gender *F*(1, 83) = 54.45, *p* < .001, η_p^2= .40 indicating a large effect, and a significant main effect of location; *F* (1, 83) = 17.98, *p* < .001, η_p^2 = .18 indicating a large effect size. However, there was a significant interaction between gender and location; *F*(1, 83) = 7.09, *p* = .009, η_p^2= .08 indicating a medium effect size. Analysis of simple effects revealed a significant main effect of gender in large towns with males (*M* = 22.44, *SD*= .74) reporting higher unsafe crossing than females (*M* = 16.88, SD .54 =); *F* (1, 83) = 37.30, *p* < .001. There was also a significant main effect of gender in cities; *F* (1,83) = 17.15, p < .001, with males (*M* = 23.32, *SD* = .33) reporting higher unsafe crossing behaviour than females (*M* = 20.71, *SD* = .54). However, only females demonstrated a significant difference in how they behaved depending on location; *F*(3,83) = 15.47, *p* < .001 with higher reported unsafe crossing in cities (*M* = 20.71, *SD* = .54) than in large towns (*M* = 16.88, *S*D = .54). See Figure 5.10 for the interaction. Therefore, we reject the null hypothesis for H1, H2 and H3 as there were significant relationships between all variables.

Figure 5.10

Interaction between Location and Gender in Children's Unsafe Crossing



Summary of unsafe crossing:

Males reported higher frequency of unsafe crossing than females in both large towns and cities. Females were also more likely to demonstrate more unsafe crossing in cities compared to larger towns. There was no impact of age in unsafe crossing behaviour. These results are again consistent with both the ANOVA and HLM analysis in Study 1, on the sample of 1,100 children which demonstrated that the urban location resulted in greater unsafe crossing, in particular for males. Being out around the roads more frequently on their own was also a strong predictor of unsafe crossing in the previous research. This sample also demonstrated that males were much more likely to be out around the roads on their own compared to females, so this may be an additional factor to consider when interpreting the unsafe crossing behaviour within this sample.

Section 5.4.2.3 Planned Protective Behaviour

As can be observed in Table 5.25, there was a good indication of compliance with the rules of the road 'look both ways before crossing' and was similar compared to the sample in Study 1, Chapter 4 where the mean was 4.5. There was also a much lower than expected mean for ensuring traffic had stopped at before crossing on a pedestrian crossing (3.14) as the mean in the sample of Study 1 was 4.0. The use of reflective clothing was also a lower than in Study 1 (2.6), however, walking in single file and facing the traffic were very similar with the previous study. One explanation of this may be the urban setting as we have already discussed for unsafe crossing. However, females were more likely to demonstrate more planned protective behaviour in the previous research than males and this sample had more females than males.

Table 5.25

Planned Protective Behaviour Children

	M	*SD*	*Min*	*Max*
Look both ways before crossing?	4.9	0.29	1	5
Walk in the road facing the traffic when on roads with no footpaths? (Right side of road)	3.3	1.36	1	5
Check to make sure the traffic has completely stopped before you cross at a pedestrian crossing?	3.1	1.5	1	2
Walk in single file on roads without a footpath?	2.3	1.49	1	5
Wear reflective clothing when walking on roads?	1.6	1.10	1	5

A composite scale was created called 'planned protective behaviour' based on the 5 items from the ARBQ in Table 5.25. Prior to the analysis an investigation of the normality indicated the KS test was significant, D (125) = .18, however, the level of skew (.20) and kurtosis (-.33) fell within the lower accepted range (-/+ 1). Therefore, combined with a visual inspection of the histogram, this scale approximated a normal distribution and deemed suitable or ANOVA. A two-way ANOVA was run on gender (males and females) and age (11 and 12 years). As the Levenes test was significant; F (3,83) = 15.47, p < .001, a more stringent alpha of .01 was set to interpret main effects and interactions.

There was a significant main effect of gender F(1, 121) = 23.74, p < .001, η_p^2= .16 indicating a large effect with , with females (M = 15.90, SD = .2.65) reporting higher planned protective behaviour than males (M = 14.23, SD = 2.69). There was also a significant main effect of age; F (1, 121) = 18.08, p < .001, η_p^2 = .10 indicating a medium effect size, with 12-year-olds (M = 15.66, SD = 3.18) reporting higher Planned protective behaviour than 11-year-olds (M = 14.62, SD = 2.01). There was no significant interaction; F (1.121) = .51, p = .48.

As with the previous analysis for unsafe crossing, due to no males being in the country location, a two-way ANOVA was run on gender (males and females) and location (large town and city). As the Levenes test was non-significant; F (3,83) = 2.26, p = .09, therefore alpha $p <$ .05 was set to interpret main effects and interactions.

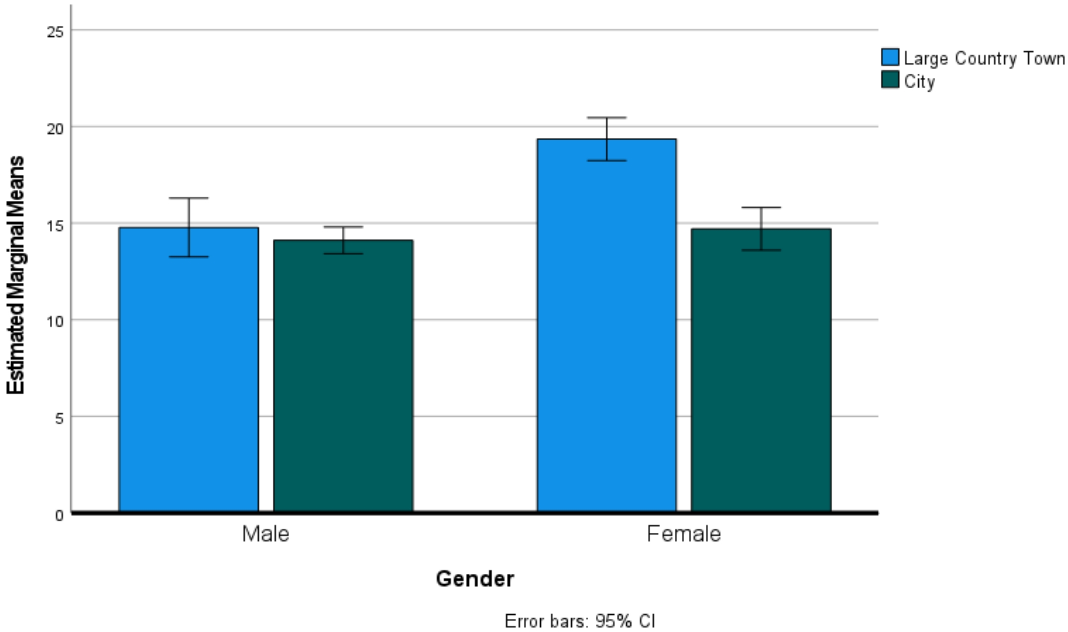
There was a significant main effect of gender $F(1, 83) = 20.49$, $p < .001$, $\eta_p^2 = .20$ indicating a large effect, and a significant main effect of location; F (1, 83) = 21.29, $p < .001$, $\eta_p^2 = .20$ indicating a large effect size. However, there was a significant interaction between gender and location; $F(1, 83) = 11.97$, $p = < .001$, $\eta_p^2 = .22$ indicating a large effect size. Analysis of simple effects revealed a significant main effect of gender in large towns with females (M = 19.53, SD= .56) reporting higher planned protective behaviour than males (M = 14.78, SD .77 =); F (1,83) = 23.37, $p < .001$, $\eta_p^2 = .30$. There was no significant gender difference in planned protective behaviour in cities. There was also a significant simple main effect of location for females only; F (1,83) = 34.83, $p < .001$, $\eta_p^2 = .30$, with females reporting higher planned protective behaviour in large town (M = 19.35, SD = .56) than in cities (M = 14.71, SD = .58). See Figure 5.11 for the interaction.

Summary of children's planned protective behaviour

The results indicate that there is a significant main effect of gender on planned protective behaviour, however, this is significant for females only in large urban towns as there was no difference in their behaviour in cities. Further, females also demonstrated significantly lower planned protective behaviour in cities than in large towns. These results remain consistent with the ANOVA and HLM findings in Chapter 4 where in the Study 1 with 1,100 children, children were more likely to engage in planned protective behaviour in rural rather than urban locations, also females demonstrated more planned protective behaviour in rural areas, but males and females did not differ in their planned protective behaviour in large urban areas. Therefore, again, it would appear that it is the urban location that is driving lower planned protective behaviour in both genders. Unlike in the previous research, the older children aged 12 years were more likely to engage in more planned protective behaviour than those in the 11-year-old age group. This is interesting as in this sample, the greater proportion of 12-year-olds were male, however, there did not appear to be any interaction between age and gender. Males were more likely to be out more on the roads therefore, increasing their exposure to traffic. In the previous research, exposure was a positive predictor of planned protective behaviour which may help to explain this finding.

Figure 5.11

Interaction Between Location and Gender Planned Protective Behaviour



Section 5.4.3 Predicting Child Unsafe Crossing

To build on research in Study 1 with 1,100 children, where gender, responsibility beliefs, near miss and levels of accompaniment were already assessed, a series of additional variables unique to this current study on 125 children were entered into a hierarchical linear regression to assess the impact of each, on the unsafe crossing reported by the children. The variables included are set out in Table 5.26. Demographic variables were entered in block one, followed in block two by attitudinal and behaviour variables.

Table 5.26

Predictor Name, Type and Coding Children's Unsafe Crossing

Variable	*Type*	*Coding*
Child Gender	Binary	0 = Male
		1 = Female
Child Age	Continuous	
Birth order	Continuous	
Near Miss	Binary	0 = No
		1 = Yes
Safety of Environment	Binary	0 = Safe
		1 = Unsafe
Volume of Traffic	Binary	0 = Heavy
		1 = Light
Walk to School	Binary	0 = Safe
		1 = Unsafe
Responsibility belief	Continuous	
Accompanied by adult	Continuous	
Accompanied by friend	Continuous	
Frequency of being out on own	Continuous	
Risk rating	Continuous	
Planned protective behaviour	Continuous	

Unlike the model for parents where previous history of an RTC was included and found to be a significant predictor, there was insufficient data from the children to include it in this model.

Step 1: The demographic variables gender, age and birth order were added in step 1, explaining 45% of the total variance in parent perception of risk, F (3, 116) = 31.32, $p < .001$.

Step2: After adding the attitudinal and behaviour variables at step 2, the total variance explained raised to 88%, after controlling for the demographic variables; F (2, 107) = 65.99, p

< .001. The addition of attitudinal and behaviour variables increased the variance explained by 43%, *R* square change = .043, *F* Change (9, 107) = 43.29, *p* < .001.

In the final model, the child's gender, birth order, near-miss, responsibility beliefs and frequency of being out on the road on their own were significant, Table 5.27 sets out the full results for each model.

Table 5.27

Hierarchical Multiple Regression Summary for Child Pedestrian Behaviour

	B	*Std. Error*	*Beta*		*sr*	*Change R^2*	*R^2*
Step 1						.448***	.448
(Constant)	21.01	2.47					
Child birth order	0.82	0.21	0.27	***	0.26		
Age	-0.68	0.54	-0.11		-0.09		
Gender	-4.04	-0.55	-0.63	***	-0.51		
Step 2						.436***	.88
(Constant)	29.54	1.67					
Child birth order	0.75	0.12	0.25	***	0.21		
Age	-0.71	0.39	-0.11		-0.06		
Gender	-2.02	-0.61	-0.32	***	-0.11		
Near miss	1.85	0.38	0.23	***	0.16		
Risk rating	0.14	0.08	0.09		0.05		
Responsibility belief	-0.37	0.04	-0.59	***	-0.30		
Rate safety around home	-0.14	0.16	-0.05		-0.03		
Rate volume of traffic home	-0.16	0.20	-0.04		-0.03		
Travel to school	0.29	0.32	0.05		0.03		
Accompanied by adult	-0.07	0.23	-0.02		-0.01		
Accompanied by friend	0.23	0.24	0.10		0.03		
Frequency of being out on own	0.49	0.23	0.20	***	0.07		
Planned protective behaviour	-0.09	0.06	-0.08		-0.06		

*** *p* < .001

The strongest predictor accounting for the greatest amount of variance (9%) on its own was responsibility beliefs (*sr* = .30), where higher responsibility beliefs, the lower the unsafe crossing reported. The second strongest predictor was birth order (*sr* =. 21), accounting for 5% of the variance, indicating that children who are higher in birth order demonstrate more unsafe crossing. The third highest was near -miss experience (*sr*=.16) accounting for 2.6% with having at least one increasing the reported unsafe crossing. The next was gender (*sr* = .17) accounting for 2.7% of the variance where males demonstrated higher reported unsafe crossing than females. The final significant predictor, frequency of walking around the town on their own (*sr* = .03) accounting for less than 1% of the variance. Interestingly, planned protective behaviour was a non-significant predictor of their unsafe crossing. However, the results remain consistent with that of the previous study where males, having a history of a near miss and higher frequency of walking on their own were all significant predictors resulting in more unsafe crossing. The variable item of interest that was not tested previously was the birth order. This may be influenced by having older siblings.

Section 5.4.4 Discussion on Predictors of Child Unsafe Crossing

Consistent with the findings of Study 1, in the final model, the child's gender, birth order, near-miss, responsibility beliefs and frequency of being out on the road on their own were significant. Interestingly, in this study, the responsibility beliefs were the strongest predictor of behaviour, and the majority of the children were living in a city or urban areas. This again demonstrates the strength of these internal beliefs over their own control and responsibility for their safety on the roads. It also lends support to the finding that these beliefs combined with the urban environment are key predictors rather than education, as discussed in the previous study. Once responsibility beliefs were entered into those previous models for unsafe crossing and dangerous play, education became non-significant. The relationship between education and location demonstrated that it was only evident in the urban populations. Therefore, it may have been a spurious finding based on the fact that children in those urban schools were reporting more unsafe crossing, just as the urban location was consistently the strongest predictor for unsafe crossing. The finding that being male, a previous history of a near miss and being out around the roads alone again are consistent with Study 1, where these behaviours have been interpreted in light of previous literature and theory. What was unique to this study, was the impact of birth order, where being born later in the family, increased the unsafe crossing. This of course may be attributable to the presence of siblings and the lowering of supervision with more children in the home.

The impact of older siblings and peers on children's risk decisions has been confirmed in research by Morrongiello and Bradley (1997) as after the appeals of older siblings, younger children significantly shifted their decisions: choices of less risky paths replaced the initial selection of more risky paths, and vice versa. A positive sibling relationship was predictive of younger siblings' decision changes. Boys and girls were equally effective in persuasion, but they did so using different types of arguments, with boys communicating primarily appeals to fun and girls emphasizing appeals to safety. It may also be an established impact of peers, as younger children may more often be supervised by older siblings and their friends. Studies have suggested that the number of children in the household may influence parents' supervision of their children and have suggested that parents with more than one child may be laxer (Hao et al., 2008; Leong et al. 2001). Similarly, a study by Averett et al. (2009) found that having an older sibling decreased the likelihood of a child always having supervision. Therefore, the presence of an older sibling may have an impact on both the level of supervision the younger child receives and also the impact the young child's level of risk taking.

Therefore, this second study has confirmed findings from the larger sample of 1,100 children in Study 1, on the impact of gender, a previous history of a near miss, higher frequency of being out around the roads alone all increasing unsafe crossing. The interesting new addition is the birth order supports previous research on the power of peer influence, either by siblings or other children and role of supervision on children by parents in modelling good road use behaviour.

Section 5.5 Child Pedestrian Attitudes and Perception of Risk

Section 5.5.1 Volume of Traffic and Safety Rating

Children were asked to rate the volume of traffic around their home and also to rate their perception of the traffic safety around their home. There was a fairly even distribution of ratings of safe and unsafe, with the biggest majority rating it as light traffic (Table 5.28). Interestingly, even though the children rated the traffic volume as light in 56% percent of the cases, approximately 71% rated the traffic environment as unsafe or very unsafe (Table 5.29).

Table 5.28

Childs Perception of Traffic Volume around Home

	N	%
Very light traffic	15	12.0
Light traffic	55	44.0
Heavy traffic	49	39.2
Very heavy traffic	6	4.8
Total	125	100

Table 5.29

Childs perception of Traffic Safety Around Home

	Frequency	Percent
Very safe	4	3.2
Pretty Safe	32	25.6
Unsafe	68	54.4
Very unsafe	21	16.8
Total	125	100

Section 5.5.2 Perception of Danger for Certain Behaviours

Interestingly, almost all the children rated crossing without looking as always dangerous (Table 5.30). However, it is interesting how low they rate playing on a footpath. This may be driven by their personal experience of living and playing/ socialising on footpaths in cul-de-sacs and estates as this is where the majority of this sample reside. They also have a very low risk assessment for crossing when a pedestrian light is red, but no traffic is coming. This may demonstrate an overestimation of their ability to cross safely and a tendency to break the rules.

Table 5.30

Percentage Rating of Danger for Child Road Safety in Different Circumstances

	Always Dangerous	*Often Dangerous*	*Sometimes Dangerous*	*Rarely Dangerous*	*Never Dangerous*
Crossing the street without looking	96.8	3.2	0.0	0.0	0.0
Playing on a country road	27.2	72.8	0.0	0.0	0.0
Crossing the street other than at a pedestrian crossing (with and without signal)	19.2	33.6	16.8	25.6	4.8
Crossing the street from between parked cars	11.2	40.8	32.0	16.0	0.0
Crossing at a pedestrian crossing without traffic lights	8.0	30.4	40.0	18.4	3.2
Crossing when the pedestrian light is red and there are no cars coming	7.2	11.2	20.0	49.6	12.0
Playing on the footpath	0.0	0.0	15.2	48.0	36.8
Crossing when the pedestrian light is green	0.0	0.0	4.0	54.4	41.6

Gender: To assess any differences between genders on perception of risk, a t-test was run. Prior to running this test, a test of the assumptions underlying parametric analysis was conducted. The KS test was significant for males, D (53) = .28, p < .001 and females D (72) = .19 p < .001). A visual inspection of the females indicated some skewness (.41) and kurtosis (-1.06) however, it was deemed to fall within the acceptable range. A visual inspection of the males indicated some skewness (-1.79) and kurtosis (1.7) however, it was deemed to fall within the acceptable range. Further, the Levenes test indicated homogeneity of variance, F (1,123) = 1.0, p = .32. Therefore, the data were considered suitable for parametric analysis.

While there was a slightly higher perception of risk observed in females, there was no significant difference between males (M = 22.33, SD = 2.63) and females (M = 23.38, SD = 3.5) perception of risk, t(123) = 1.90, p = .06.

Section 5.5.3 Responsibility Beliefs

Children were asked to rate their level of agreement with the statements in Table x ranging from 'Strongly Agree' to 'Strongly Disagree'. These items were designed to measure a respondent's beliefs about how risky or safe they perceived their behaviour to be and assessed their belief about who should be responsible for their safety while on the road. Examination of the KMO (0 .72) and Bartletts Test of Sphericity ($p < .001$) indicate the data is suitable for factor analysis.

The seven questions on beliefs were subjected to a principal axis factor analysis with varimax rotation. The data were best fitted by a two-factor solution accounting for 68.3% of the variance (Table 5.31). Factor 1 accounted for 42.02% of the variance and included items concerned with taking responsibility for their own safety and acting responsibly. Factor 2 accounted for 26.25% of the variance. The two items on this factor deflected responsibility for their own behaviour. Both factors and their associated loadings are set out in Table 5.31.

Table 5.31

Factor Loadings Children's Road Safety Responsibility Beliefs

Item	*Factor 1*	*Factor 2*
I do things that are risky when out around roads	**-0.53**	0.04
I generally pay a lot of attention to traffic when out around roads	**0.71**	-0.12
In general, I act responsibly when out around roads	**0.62**	-0.23
I am aware of the dangers around the roads	**0.55**	-0.13
I should be responsible for my safety when I am out around roads	**0.71**	-0.45
Drivers should be responsible for my safety when I am out around roads	-0.18	**0.72**
Other people should be responsible for my safety when I am out around roads	-0.16	**0.83**

The five items on Factor 1 were summed to produce a composite scale titled 'Responsibility Beliefs'. As one item negatively loaded onto this factor 'I do things that are risky when I am out on the roads' (Table 5.31) it was reversed coded so that higher scores on all items represented a stronger attitude of personal responsibility. This scale had a Cronbach Alpha of 0.79. The 2 items on Factor 2 were summed to produce a composite scale called 'Deflected Responsibility Beliefs' with a Cronbach Alpha of .76. Higher scores on this scale indicated less desirable road safety beliefs. The reliability remains very similar to that of the original research (Elliott & Baughan, 2004) with reliability of .76 (Factor 1) and .74 (Factor 2). Table x sets out the means and SDs of these two scales.

This pattern of loadings and reliability remain consistent with that from the research in Study 1 (1, 100 children). Similarly, like in the original research, 'I should be responsible for my safety when I am out around roads' and 'other people should be responsible for my safety when I am out around roads' did not load onto the same factor. According to Elliott and Baughan (2004), this may be because adolescent road users may believe that both they and others like motorists have a role to play in their safety while on the road. A high score indicates high responsibility, and low scores indicates lower deflected beliefs. As can be seen in Table 5.32, there was a high mean score for responsibility beliefs with a corresponding low mean for deflecting beliefs.

Table 5.32

*Descriptive statistics for Responsibility Beliefs and Deflected Responsibility Beliefs Scale*s

	Min	*Max*	*M*	*SD*
Deflection Beliefs	3	10	7.91	1.95
Responsibility Beliefs	9	25	18.54	4.95

Gender: To assess any differences between genders on responsibility beliefs and lend support to Study1, a t-test was run. Prior to running this test, a test of the assumptions underlying parametric analysis was conducted. The KS test was significant for males, $D(53) = .19$, $p < .001$ and females $D(72) = .18$ $p < .001$). A visual inspection of the females indicated some skewness (-1.04) and kurtosis (.23) however, it was deemed to fall within the acceptable range. A visual inspection of the males indicated some skewness (-.12) and kurtosis (-1.29) however, it was deemed to fall within the acceptable range. Further, the Levenes test indicated homogeneity of variance, $F(1,123) = 3.04$, $p = .08$. Therefore, the data were considered suitable for parametric analysis. There was a significant gender difference with males ($M = 15.04$, $SD = 4.01$) reporting significantly lower responsibility beliefs than females (*M* = 21.11, *SD* =3.8); *t*(123) = 8.54, *p* < .001. The mean difference was 6.07 (CI: 4.67 – 7.48), Cohen's d = 1.54 representing a large effect.

Prior to running this test, a test of the assumptions underlying parametric analysis was conducted. The KS test was significant for males, *D*(53) = .25, *p* < .001 and females *D*(72) = .16 *p* < .001). A visual inspection of the females indicated some skewness (-.53) and kurtosis(- .57) however, it was deemed to fall within the acceptable range. A visual inspection of the males indicated some skewness (-1.67) and kurtosis (-1.89) however, it was deemed to fall within the acceptable range. Further, the Levenes test indicated homogeneity of variance, *F* (1,123) = 1.0, *p* = .32. Therefore, the data were considered suitable for parametric analysis.

There was a significant gender difference with males (*M* = 8.38, *SD* = 1.8) reporting significantly higher deflected beliefs than females (*M* = 7.57, *SD* = 1.9); *t*(123) = 2.3, *p* =.02. The mean difference was very small, 0.8 (CI: 1.49 -.12), Cohen's d = 0.42 representing a medium effect.

These results are consistent with Study 1 where females demonstrated higher responsibility beliefs and lower deflected beliefs than males.

Section 5.5.4 Predicting Child Perception of Risk Perception

Hierarchical multiple linear regression will be employed to assess the impact of a series of variables on the dependent variable, child perception of risk (Table 5.33). Some of the Likert variables have been collapsed into two levels to reduce the complexity of variables entered into the regression, while still maintaining integrity of the variable. Converted variables are set out below and Table 5.33 sets out the variables name, type and coding.

- Safety of Environment: Collapsed from 5 levels to 2 levels from 'very safe', 'pretty safe', 'nether safe or unsafe', 'a little unsafe' and 'very unsafe' to 'Safe' and 'Unsafe'. This was reduced due to the level of extreme rating at either end of the scale.
- Volume of Traffic: Collapsed from 4 levels to 2 levels from 'very light', 'light', 'heavy' and 'very heavy' to 'Heavy' and 'Light'.
- Transport to School: If walked then coded as 1 and all other forms of transport coded as 0.

Table 5.33

Name, Type and Coding of Predictor Variables Children Perception of Risk

Name	Type	Coding
Child Gender	Binary	0 = Male
		1 = Female
Child Age	Continuous	
Birth order	Continuous	
Safety of Environment	Binary	0 = Safe
		1 = Unsafe
Volume of Traffic	Binary	0 = Heavy
		1 = Light
Near Miss	Binary	0 = No
		1 = Yes
Walk to School	Binary	0 = Safe
		1 = Unsafe
Accompanied by adult	Continuous	
Accompanied by friend	Continuous	
Frequency of being out on own	Continuous	
Unsafe Crossing behaviour	Continuous	
Planned protective behaviour	Continuous	

Prior to running the hierarchical regression, the data was assessed to ensure there were no violations of the assumption of normality, linearity, homoscedasticity and independence of residuals. The variables were entered in 5 blocks in keeping with the proposed extended model with each block representing:

1. Demographic variables
2. Environment variable

3. Mobility variables
4. Cognitive/attitudinal variables
5. Behaviour variables

Step 1: The demographic variables gender, age and birth order were added in step 1, explaining 10% of the total variance in parent perception of risk, F (3, 116) = 4.11, p = .008.

Step2: After adding the environment variable, traffic volume at step 2, the total variance explained did not increase (10%) after controlling for the demographic variables; F (4, 115) = 3.06, p = .02. The addition of traffic volume did not significantly increase the variance explained, R square change = .0-, F Change (1,115) = .046, p = .81.

Step 3: The variables relating to mobility, frequency of walking with adults, friends or on own and mode of transport to school were included, and the variance raised to 25%, F (8,111) =4.67, p < .001. These variables increased the overall variance by 15.6%, R square change = .156, F Change (4,111) = 5.78, p < .001.

Step 4: The variables relating to cognitive factors including, safety rating of location, responsibility beliefs and deflected responsibility beliefs raised the total variance explained to 28%; F (11, 108) = 3.76, p < .001. These new variables explained an additional 3% of the variance, but this change was non-significant, R square change = .03, F change (3,108) = 1.24, p =.30.

Step 5: A two additional variables were added that were not previously in the model. This is the child's own self-reported pedestrian behaviour and the near miss experience. Once these variables were included that variance increased to 36%; F (13, 106) = 4.51, p < .001. The reported parent behaviour explained on its own an additional 8%, R square change = .08, F change (2, 106) = 6.49, p = .002. In the final model, only four of the predictors were significant.

Table 5.34 sets out the summary of results for each model.

Table 5.34

Hierarchical Regression Summary of Child Perception of Risk

	B	*SE B*	*Beta*		*sr*	*Change R^2*	*R^2*
Step 1						.10	.01
(Constant)	30.10	3.15					
Birth order	-0.63	0.27	-0.21	**	-0.20		
Age	-1.54	0.69	-0.25		-0.20		
Gender	-2.12	-0.70	-0.33		-0.27		
Step 2						.00	.10
(Constant)	30.00	3.20					
Birth order	-0.61	0.28	-0.20	**	-0.19		
Age	-1.50	0.73	-0.24		-0.18		
Gender	-2.12	-0.70	-0.33		-0.27		
Traffic volume	-0.16	0.76	-0.02		-0.02		
Step 3						.15***	.25
(Constant)	32.00	3.26					
Birth order	-0.42	0.30	-0.14	**	-0.12		
Age	-1.74	0.78	-0.28		-0.18		
Gender	-3.98	-0.87	-0.62		-0.38		
Volume traffic	0.02	0.80	0.00		0.00		
Walk to school	-0.99	0.38	-0.32	***	-0.21		
Accompanied by adults	0.18	0.55	0.05		0.03		
Accompanied by friends	0.74	0.45	0.31		0.14		
Frequency out on own	-0.97	0.48	-0.40		-0.17		
Step 4						.03	.28
(Constant)	31.16	3.70					
Birth order	-0.47	0.34	-0.15	**	-0.11		
Age	-1.76	0.79	-0.28		-0.18		
Gender	-4.01	-1.13	-0.63		-0.29		
Volume traffic	-0.42	0.97	-0.05		-0.04		
Walk to school	-1.04	0.41	-0.33	***	-0.21		
Accompanied by adults	0.43	0.62	0.13		0.06		
Accompanied by friends	0.35	0.61	0.14		0.05		
Frequency out on own	-0.98	0.56	-0.41		-0.14		
Responsibility belief	-0.03	0.08	-0.04		-0.03		
Deflected beliefs	0.32	0.18	0.20		0.15		
Rate safety around home	-0.50	0.71	-0.08		-0.06		
Step 5						.08**	.36
(Constant)	12.84	7.70					
Birth order	-1.47	0.44	-0.49	**	-0.26		

Age	-1.37	0.77	-0.22		-0.14
Gender	-0.52	-1.45	-0.08		-0.03
Volume traffic	1.62	1.14	0.21		0.11
Walk to school	-1.90	0.46	-0.60	***	-0.32
Accompanied by adults	0.79	0.60	0.24		0.10
Accompanied by friends	-0.46	0.63	-0.19		-0.06
Frequency out on own	0.45	0.67	0.19		0.05
Responsibility belief	0.16	0.13	0.25		0.10
Deflected beliefs	0.20	0.18	0.12		0.09
Rate safety around home	-0.88	0.69	-0.14		-0.10
Near miss	-3.45	1.14	-0.44	**	-0.24
Child unsafe crossing	0.85	0.26	0.85	**	0.26

*Note. ** $p < .01$; *** $p < .001$*

Of the four significant predictors, walking to school was the strongest predictor (*sr* =.32), of decreased risk perception accounting for 11% of the variance which in this case is almost a third of the total variance. The second was birth order (*sr* =. 26) accounting for 7% of the variance, where being born later in the family decreased the perception of risk. The child's previous reported unsafe crossing (*sr* = .26) accounted for 7% of the variance, where higher unsafe crossing resulted in higher perception of risk. Finally, the experience of having a near miss (*sr* =. 24) accounted for 6% of the variance and decreased the perception of risk.

Summary of child prediction of risk:

Overall, while the model did highlight some important factors which could help identify predictors of risk perception such as the exposure to traffic, particularly in an urban location as the majority of this sample resided. Being surrounded by heavy traffic while walking to school every day at rush hour seems to have lowered their perception of danger. Being born later in the family decreased the perception of risk. This may be due to older siblings taking more risks on the road while crossing or walking in company with no negative consequences. The higher the child's reported unsafe crossing the higher the perception of risk and interestingly, the experience of a near miss decreases the perception of risk.

Section 5.5.5 Discussion on Predictors of Child Perception of Risk

Overall, while the model highlighted some important factors which could help identify predictors of risk perception such as the exposure to traffic, particularly in an urban location Being surrounded by heavy traffic while walking to school every day at rush hour may have reduced the perception of danger, or it may be a reflection of their parent's perception of risk. Having older siblings may also impact perception of risk due to less supervision by the parent and the peer influence of older siblings and their friends. The higher the child's reported unsafe crossing, the higher the risk perception, however, the experience of a near miss decreases the perception of risk.

Of the four significant predictors, walking to school was the strongest predictor, reducing the perception of risk. This is interesting as there was no significant impact of traffic volume, or the safety rating for the traffic around their home. However, it may have been impacted by habituation of heavy traffic lowering the perception of danger (Elliott & Baughan, 2004) or just the greater experience of navigating traffic. The other predictors were being born later in the family (shown earlier to be a negative influence on behaviour), the experience of having a near miss event and their previous high reporting of unsafe crossing. It could be suggested that their perception of lower risk has been moulded by their experiences of walking to school, possibly in the company of older siblings, where they have engaged in unsafe crossing or observed unsafe crossing without negative consequences. Further, they have experienced a near miss event themselves, but may have processed that as not having negative consequences. It has been discussed how having a near miss and continuing to cross in an unsafe manner may be an example of social learning in children where they persist in behaving in a risky manner due to there being no negative consequences (not actually being hit). This was also supported by the power of previous behaviour in the TPB studies to predict future behaviour. However, there is a disconnect then between their apparent previous history of more risky road use and their higher perception of risk. One would assume that if they keep perpetuating the behaviour with what they perceive as no negative consequences, it will have the impact of lowering their perception of risk. The opposite has happened here. Therefore, do they in fact realise that it is risky and simply due to their heightened propensity for risk in the 11 to 12-year-old age group, keep behaving that way as the excitement outweighs the potential injury. They may also be experiencing unrealistic optimism. These findings are remarkably similar to the parents who also demonstrated more unsafe road crossing but still reported increased risk perceptions for their children. This demonstrates the power of cognitive strategies to constantly relieve the tension between behaviour and attitudes or beliefs. It was interesting in this sample of children that responsibility beliefs were not a significant predictor of their perceived risk. There may be a potential impact of an underlying family culture of road safety where the parents are telling their children that the roads are unsafe, while at the same time modelling unsafe road crossing.

Section 5.6 Parent and Child Behaviour and Perception of Risk

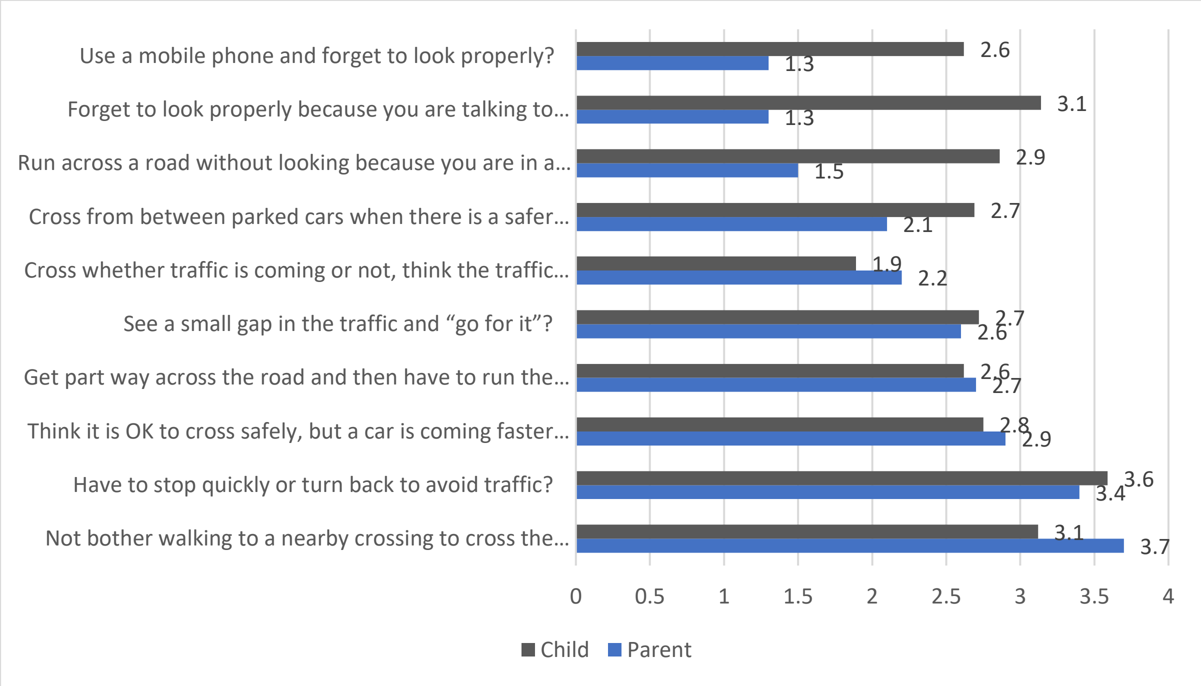
In order to assess the level of similarity between the parents and children's reported behaviour and attitudes, a series of zero order correlations were run. This will help assess the accuracy of these parents' perceptions of their children's pedestrian ability and study the potential impact of their behaviour when crossing the road in the presence of their children. Studies on parental modelling and road use behaviour while in the presence of their children are usually observational in nature (e.g. Morrongiello & Barton, 2009; Holm et al., 2018), however, in this study they were matched pairs who completed a self- report questionnaire on their own behaviour, attitudes and beliefs. Assumptions of normality, linearity and homoscedasticity were assessed for each pair and the assumptions were not violated.

Section 5.6.1 Comparison of Parents Reported Crossing with Children's Reported Crossing

The mean score for each of the items by parent and child are displayed in Figure 5.12. Higher means indicate less desirable road safety behaviour. The scale was rated from 1 'never' to 5 'very often'. The mean overall score for parents unsafe crossing was 21.86 (SD 5.56) and the children's mean was 21.04 (3.08). As can be seen in Figure 5.12, there is a high level of self-reported unsafe crossing by parents in the presence of their children, in particular, not bothering to walk to a nearby crossing to cross the road and also having to stop quickly or turn back to avoid traffic. This behaviour is problematic as children of 11 to 12 years do not have the same perceptual ability as adults to accurately judge the speed of oncoming traffic (O'Neal, 2018). Therefore, if they observe this behaviour on a frequent basis when in the company of parents who may be able to cross safely, when on their own this could potentially result in a near miss or more serious incident on the road. Children, on the other hand have reported a higher level of distraction than parents due to the use of a mobile phone or crossing in the company of their friends.

Figure 5.12

Mean Reported Unsafe Crossing by Parents and Children



While Figure 5.12 illustrates a simple comparison and visual inspection of the group means, a Pearson's correlation was run on each pair of indices. Table 5.35 sets out these correlations between parent and child. There was a moderate to strong correlation between what the parent reported and what the child reported apart from the two particularly dangerous behaviours resulting in having to take evasive action to avoid being hit by the oncoming vehicle.

Table 5.35

Pearson Correlation of Parent and Child Reporting of Unsafe Crossing

Item	*r*
Cross from between parked cars when there is a safer place to cross nearby	.68
See a small gap in the traffic and "go for it"?	.52
Forget to look properly because you are talking to people/child(ren) who are with you?	.49
Think it is OK to cross safely, but a car is coming faster than you thought	.44
Cross whether traffic is coming or not, think the traffic should stop for you	.44
Not bother walking to a nearby crossing to cross the road?	.35
Run across a road without looking because you are in a hurry	.29
Use a mobile phone and forget to look properly?	.15
Get part way across the road and then have to run the rest of the way to avoid traffic	.10
Have to stop quickly or turn back to avoid traffic?	.01

Further analysis on the mean of the 10 items was conducted to assess the level of correlation between the matched pairs to indicate any potential impact of modelling across the behaviours as a whole. The Pearson's correlation was statistically significant; $r = .67$, n = 125, $p < .001$. This is a strong correlation and would suggest that there is a good degree of similarity in both what the parent has reported themselves and what the child has self-reported. However, there may be a discrepancy between what the parents are reporting and what the children perceive or observe when crossing the road with their parents. As a result, children were asked to rate how often they observed their parents crossing according to the ten items and their observations are charted against what the parents have reported (Figure 5.13). As can be seen, there is a discrepancy between what the parents have reported and what the children observed, with the children's ratings higher for unsafe crossing in many cases than the parents. While this may have been desirability responding from the parents it may also be that parents are unaware of how often they cross the road this way, when in the presence of their children.

Table 5.36 sets out the correlations between how the children have observed their parents crossing when they are walking with each other and their own reported behaviour. It is very interesting to note that the correlations between what the child has observed and how they themselves behave are much higher than those between what the parent reported themselves as doing. In particular, correlations are much stronger for several of the items such as 'cross whether traffic is coming or not' (jay walking), 'think its ok to cross but a car is coming faster than you though' ' cross from between parked cars' and 'not bother walking to a nearby crossing to cross the road'. These are all very risky behaviours for an 11- to 12-year-old child to observe their parents performing and to perform themselves when unaccompanied, given the challenges that children in this age group have with accurately assessing the gap between traffic compared to adults and the identification of unmaterialised hazards (view is obstructed).

Figure 5.13

Comparison of Observed Parental Unsafe Crossing with Parental Report of Unsafe Crossing

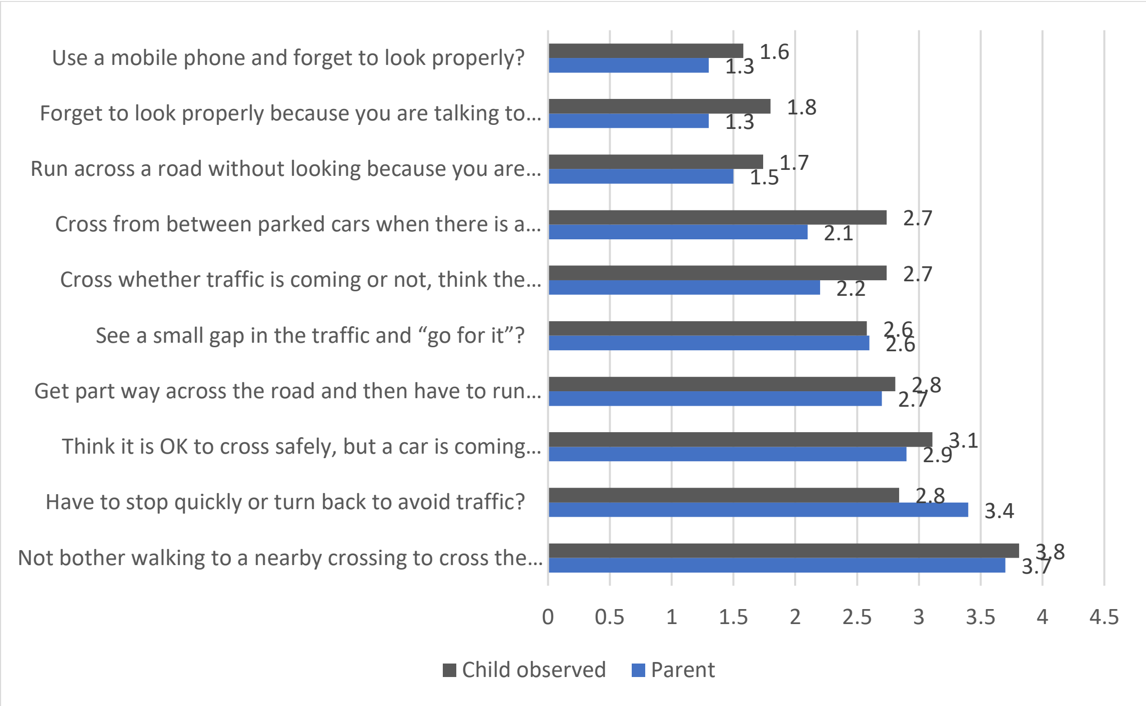


Table 5. 36

Correlation between Observed Parent Unsafe Crossing and Child Reported Unsafe Crossing

Item	*r*
Cross from between parked cars when there is a safer place to cross nearby	.67
See a small gap in the traffic and "go for it"?	.59
Cross whether traffic is coming or not, think the traffic should stop for them	.56
Think it is OK to cross safely, but a car is coming faster than they thought	.50
Get part way across the road and then have to run the rest of the way to avoid traffic	.43
Run across a road without looking because they are in a hurry	.41
Not bother walking to a nearby crossing to cross the road?	.37
Have to stop quickly or turn back to avoid traffic?	.27
Use a mobile phone and forget to look properly?	.11
Forget to look properly because you they are talking to people/child(ren) who are with them?	.04
Mean correlation	.40

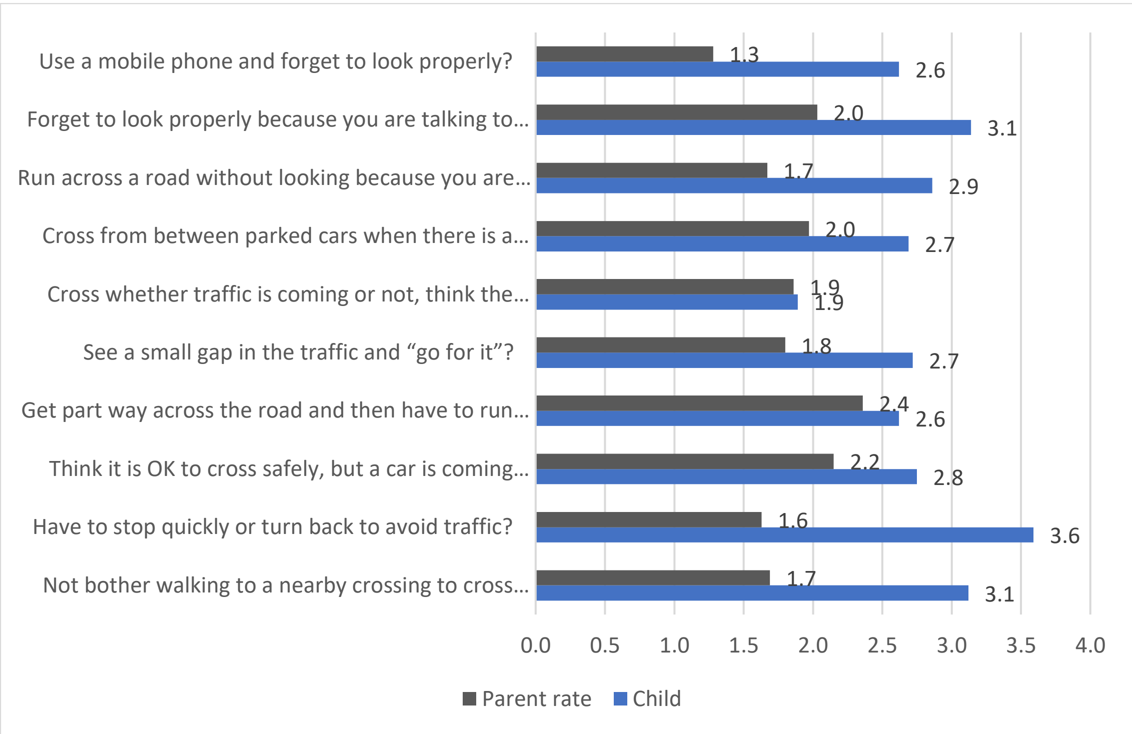
Another Pearson's correlation was run on the mean for the full 10 items for the matched pairs to assess the level of correlation between what the child had observed and their own behaviour. The strength of this correlation was considerably higher, $r = .83$, $n = 125$, $p < .001$. This would be a stronger reflection of what the child has observed in the presence of their parent while crossing and their subsequent behaviour.

Section 5.6.2 Comparison of Parents Rating of Childs Crossing by Children's Reported Crossing

Parents were asked to rate how they thought their children would behave on the road when crossing. It was interesting to note that parents were considerably underestimating their level of distraction and unsafe crossing their children were reporting (Figure 5.14).

Figure 5.14

Parent Mean Rating of Child Unsafe Crossing Compared to Child Reported Unsafe Crossing



Correlations on each item were run between the parent and children's rating. As can be seen in Table 5.37 there was a very low correlation between several items such as children forgetting to look properly because they were talking to friends, crossing whether traffic was coming or not, running across the road without looking and not bothering to walk to a nearby crossing. It was interesting to note that some of these behaviours were observed by the children when they were crossing the road with their parents. This may again suggest the impact of modelling behaviour and how potentially unaware parents are on how their own actions are influencing their children's behaviour. It further illustrates the disconnect between how parents are perceiving their children's ability and behaviour and the children's actual reported behaviour.

Table 5.37

Correlation Parent Rating of Child Unsafe Crossing and Child Reported Unsafe Crossing

Item	*r*
Think it is OK to cross safely, but a car is coming faster than they thought	.70
See a small gap in the traffic and "go for it"?	.51
Have to stop quickly or turn back to avoid traffic?	.39
Use a mobile phone and forget to look properly?	.36
Get part way across the road and then have to run the rest of the way to avoid traffic	.36
Cross from between parked cars when there is a safer place to cross nearby	.31
Forget to look properly because you they are talking to people/child(ren) who are with them?	.16
Cross whether traffic is coming or not, think the traffic should stop for them	.15
Run across a road without looking because they are in a hurry	.04
Not bother walking to a nearby crossing to cross the road?	.03
Mean correlation	.30

A Pearson's correlation was run on the mean of the full 10 items for the matched pairs to assess the level of correlation between the child's self-reported behaviour and the parents rating of their child's behaviour across all indices. The strength of this correlation was lower, $r = .47$, n = 125, $p < .001$. and would indicate that parents are either underestimating their child's road crossing or overestimating their ability to cross safely and independently as observed in Table 14, when they highly rated (79%) their child's capability to cross independently. While there will inevitably be some level of discrepancy between how a parent thinks their child will behave on the road and what a child does, possibly due to the presence of optimism bias, it highlights the need to further inform parents of the risks their children may be taking or be exposed to, by crossing in an unsafe manner.

It was further assessed whether parents rated their children's behaviour differently according to their gender. A *t*-test indicated a significant difference between genders on rating of unsafe crossing with male children ($M = 21.07$, $SD = 4.26$) scoring higher than female children ($M = 16.51$, $SD = 3.92$); t (123) = 6.18, $p < .001$, two tailed. The magnitude of the difference (mean difference = 4.56, 95% CI [3.10, 6.01]) was large, (Cohens d = 1.12). This indicates that parents reported significantly more unsafe crossing for their male children than their female children.

Section 5.6.3 Comparison of Parent and Childs Reported Planned Protective Behaviour

This section examines the planned protective behaviour of both the parent and child along with the child observation of the parents' behaviour. As the majority of the sample reside in an urban area, there was a very limited exposure to walking in country areas where items such as walking in single file and walking facing the traffic when there is no footpath would be more relevant. Therefore, the focus is on the questions relating to urban environments and the use of reflective clothing. There is a very low use of reflective clothing observed, which indicates that people in urban environments do not see it as a necessity. However, in Study 1, on the larger sample of 1,100 children where 42% of children lived in a rural area, the use of reflective clothing was also quite poor.

Figure 5.15 demonstrates a high level of good practice by both parent and child on looking both ways before crossing. However, the high rate of not checking to make sure that traffic has stopped at a pedestrian crossing is a concern and is a key message when delivering road safety message for pedestrian crossing protocols. There is a lot of disparity between what the children have reported and how their parents think they would behave, in particular with regard to checking to make sure that traffic has stopped. This is interesting in light of their own behaviour indicating that they often do not wait until traffic has stopped. This reported behaviour, in combination with the parent's lower risk rating for danger when crossing at a pedestrian crossing when the light is red, but no traffic is coming, is problematic in educating children on how to observe the rules of pedestrian crossings to ensure they remain safe.

Figure 5.15

Mean Ratings for Parent and Child Reported Planned Protective Behaviour

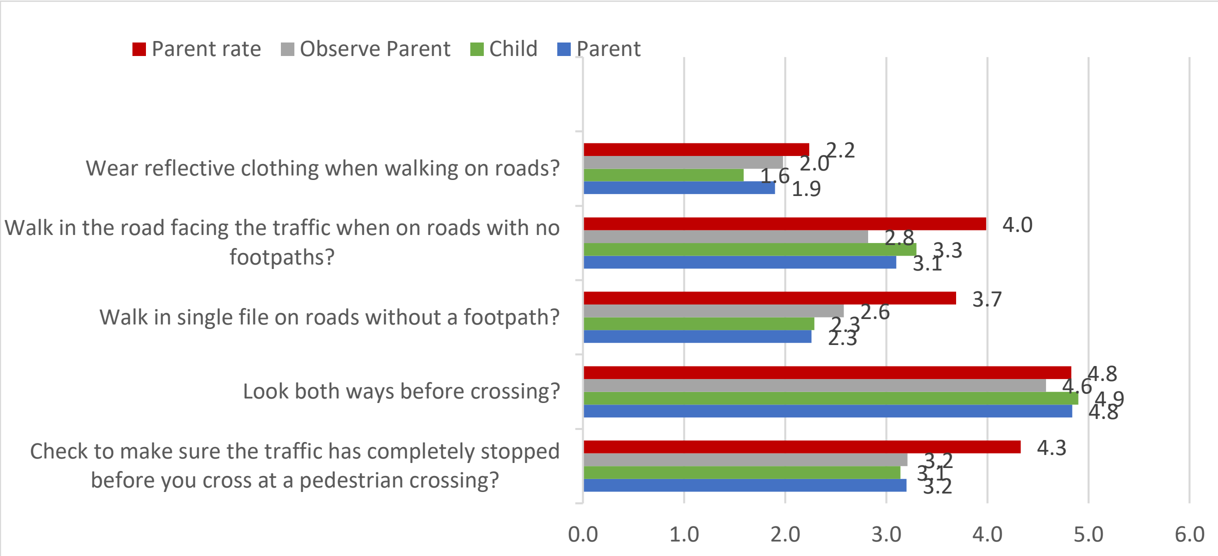


Table 5.38 sets out the correlation between the planned protective behaviours as reported by the parents and the children themselves. Some very high correlations have been reported, however, it is important to note the level of disparity as can be seen in Figure 5.15 on what the parents have reported and how the children observe their parents behaving when crossing the road.

Table 5.38

Correlation Between Parent and Child Reported Planned Protective Behaviour

Item	*r*
Walk in the road facing the traffic when on roads with no footpaths? (Right side of road)	.91
Wear reflective clothing when walking on roads?	.87
Check to make sure the traffic has completely stopped before you cross at a pedestrian crossing?	.84
Walk in single file on roads without a footpath?	.79
Look both ways before crossing?	.53

Correlations between how the children observe their parents planned protective behaviour compared to their own reported behaviour are set out in Table 5.39.

Table 5.39

Correlation Between Observed Parent and Child Reported Planned Protective Behaviour

Item	*r*
Wear reflective clothing when walking on roads?	.58
Check to make sure the traffic has completely stopped before they cross at a pedestrian crossing?	.57
Walk in the road facing the traffic when on roads with no footpaths? (Right side of road)	.57
Walk in single file on roads without a footpath?	.26
Look both ways before crossing?	.25
Mean correlation	

The correlation between the parent rating of their child's planned protective behaviour and the child's reported planned protective behaviour are set out in Table 5.39. There was an incredibly low correlation between how frequently children checked to make sure the traffic had stopped before crossing and how frequently their parents thought they would do so. Children were much less likely to report checking as can be seen in Figure 5.15.

Table 5.40

Correlation Between Parent Rating and Child Reported Planned Protective Behaviour

Item	*r*
Wear reflective clothing when walking on roads?	.74
Walk in the road facing the traffic when on roads with no footpaths? (Right side of road)	.71
Look both ways before crossing?	.44
Walk in single file on roads without a footpath?	.29
Check to make sure the traffic has completely stopped before they cross at a pedestrian crossing?	.11

Table 5.41 sets out the Pearson's correlations between the means for each of the variables and it is clear that when the pairs are matched, there is a low correlation between how the parent has reported their own planned protective behaviour and what the child observes the parent doing (r = .29) and also a low correlation between how the parent thinks their child will behave and what their child has reported (r = .39), however the correlation between both parent and child reported planned behaviour is high (r = .75).

Table 5.41

Correlation Matrix of Planned Protective behaviour Ratings

	1	2	3
1. Parent PPB	-		
2. Child PPB	.75**	-	
3. Child observe parent PPB	.29**	.45**	-
4. Parent rates child PPB	.21*	.39**	.50**

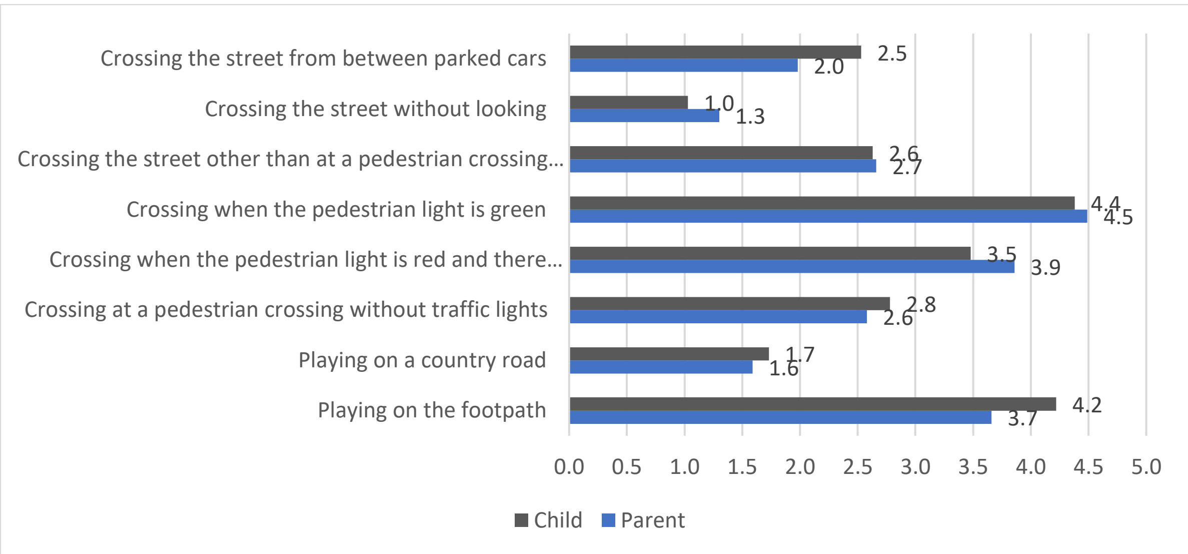
** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Section 5.6.4 Comparison of Parents and Childs Risk Rating

Parents and children were asked to rate how dangerous they perceived certain behaviours to be, ranging from 'always dangerous' to 'never dangerous. Therefore, high means indicate lower perception of danger. As can be seen in Figure 5.16 there is a perception by children that playing on a footpath is never dangerous, while the parents are a little more conservative. However, they are both high and may be indicative of a culture of using the outside footpaths as a play area when living in a cul-de-sac or estate, providing a false sense of safety.

Figure 5.16

Mean Perception of Danger Rating by Parent and Child



It was interesting to note when running the correlations on each of the danger items that two were negative, indicating that children and parents rated the danger in opposite directions (Table 5.42). Children rated crossing at a pedestrian crossing without lights as less dangerous than the parents did, while they also rated crossing without looking as more dangerous than parents. This may reflect the road safety messages they are taught at school, specifically always look left and right before you cross the road. It may also demonstrate their lack of understanding of the more complex requirements to cross a road without the assistance of traffic lights or over confidence in their own ability. It also raises the question on their acceptance of drivers taking more responsibility for their safety at a pedestrian crossing. This is an important road safety message to teach children as they were also less likely to wait for traffic to stop at a pedestrian crossing before crossing.

Table 5.42

Correlation Between Perception of Risk Parent and Perception of Risk Child

Item	*r*
Playing on the footpath	.26
Playing on a country road	.02
Crossing at a pedestrian crossing without traffic lights	-.08
Crossing when the pedestrian light is red and there are no cars coming	.25
Crossing when the pedestrian light is green	.28
Crossing the street other than at a pedestrian crossing (with and without light)	.26
Crossing the street without looking	-.12
Crossing the street from between parked cars	.36

The overall mean for parent risk was 22.1 (*SD* = 3.9) and the children's mean was 22.8 (*SD* = 3.1), with a medium correlation; $r = .53$, n = 125. This mid-range correlation indicates a certain amount of discrepancy in the matched pairs and may be related to the differences in rating for the items discussed.

Section 5.6.5 Comparison of Parents and Childs Responsibility Belief Ratings

Parents were asked to rate how they felt their child would respond to the responsibilities belief scale. It was interesting to see that the parents generally rated their children higher than the children rated themselves (Figure 5.17), in particular they felt their children would disagree more to 'I do thing that are risky when out around the roads'. This item is reverse scored so higher scores are stronger beliefs. This would correspond to the impression that their children were either capable or very capable at crossing a road independently.

Correlations were run on each item to assess the relationships between how the children and parents rated their responsibility beliefs. With the exception of the first item in Table 5.43 all correlations were extremely low.

Figure 5.17

Mean Responsibility Beliefs Rating by Parent for Child and Childs Own Rating

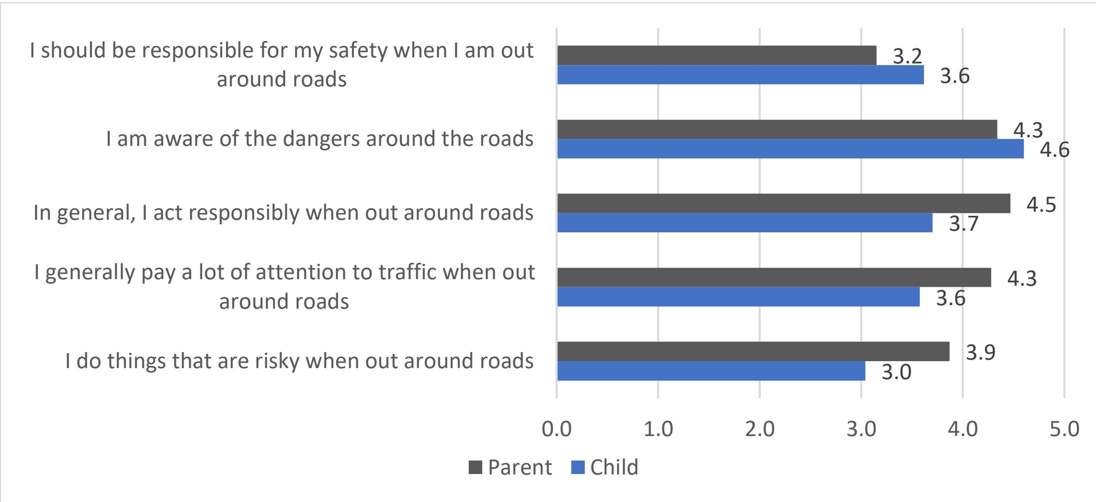


Table 5.43

Correlations between Parents and Child Rating of Responsibility Beliefs

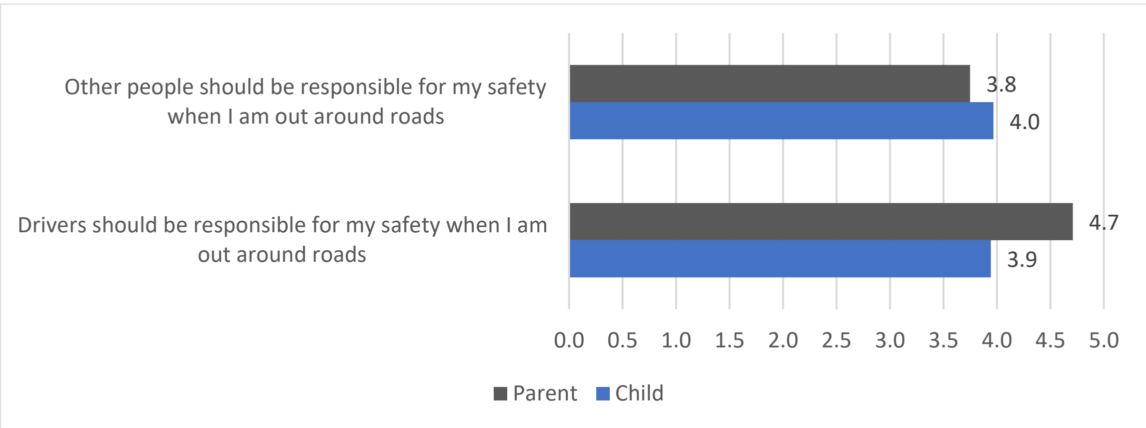
Item	*r*
I should be responsible for my own safety when I am out around roads.	.57
I do things that are risky when I am out around roads.	.04
In general, I act responsibly when I am out around roads.	.03
I am aware of the dangers around the roads.	.01
I generally pay a lot of attention to the traffic when I am out around roads.	.00

The overall mean for the parents was 20.1(SD = 2.32) and the children 18.5 (SD = 4.94). The correlation between the mean scores for the responsibility belief scale in the matched pairs was significant but very low, *r* = .22, *p* = .01. As the literature has indicated that parents tend to have different risk perceptions for male children and female children the difference in genders was assessed. There was a significant difference between the parents rating of their child's responsibility beliefs, with higher rating for females (*M* = 20.83, *SD* = 2.3), than males (*M* = 19.13, *SD* = 2.02), *t* (2, 123) = 4.33, *p* < .001, mean difference = 1.7 (CI: .92 – 2.4), Cohen's d = .78 indicating a large effect. The analysis was re-run on each gender. While there was a better strength of correlation for parents rating with their female child (*r* = .25, *p* = .01) than with their male child *(r* = .14, p =.01), both were still very low.

The deflected beliefs consisted of two items as set out in Figure 5.18. It was interesting to note that the parents thought their children would believe that drivers should be responsible for their safety, more than they themselves rated.

Figure 5.18

Mean Deflected Responsibility Beliefs Rating by Parent for Child and Childs Rating



The correlations between parent and child for deflected beliefs were stronger than those for the items in the responsibility belief scale, but only the first was a strong relationship. This would suggest that parents and children were more closely aligned in their perception that other people should be responsible for the child's safety when they are out around the roads. This is an interesting finding and could be suggestive of a family climate of deflected responsibility.

Table 4.54

Correlations Between Parent and Child Deflected Beliefs

Item	*r*
Other people should be responsible for my safety when I am out around roads.	.57
Drivers should be responsible for my safety when I am out around roads.	.24

The correlation for the mean deflected beliefs for the matched pairs was significant and stronger than that of the responsibility beliefs; $r = .53$, N = 125 $p < .001$

Section 5.6.6 Discussion of Child and Parent Comparisons of Behaviour and Beliefs

When a comparison was made initially for the self- reported unsafe crossing by the parents and their children, there appeared to be a higher degree of unsafe crossing observed in the children due to distraction and higher risk behaviours such as running across the road because they were in a hurry, crossing from between parked cars and having to turn back to avoid traffic. However, sometimes people are unaware of their behaviour as it has become habituated or, in this instance they may be liable to desirability responding. To control for this, the children were asked to rate what they observed their parents doing when crossing the roads with them. When these two sets of self-reports were compared, there was a closer alignment between what the children were actually doing and what they observed their parents doing. The correlation for this relationship rose from .67 to .83. Therefore, there is quite a strong relationship observed which may provide support for the role of parental modelling of road crossing behaviour.

As adults have a greater skill developed over time at crossing the road safely, they do not need to always use a pedestrian crossing and can better perceive the gaps in traffic and the estimated time for arrival to the other side of the road. As noted in the previous research, children do not have these skills (Barton & Morrongiello, 2011; Meir et al., 2013, 2015a; 2020; Tabibi & Pfeffer 2007; Tapiro, et al., 2018; Tolmie et al., 1998) until they are closer to 14 years of age. Therefore, the impact of modelling these behaviours on this age group needs to be considered. There is a vital role for parents to model how to cross a road safely when there are no crossings available. Holm et al. (2018) pointed out how important parents are as role models for adolescents when it comes to traffic behaviour. The role model behaviour with the strongest effect on adolescent high-risk behaviour in traffic is the role model not using pedestrian crossings to cross the street. The results also showed that higher-risk traffic behaviour by adolescent pedestrians is predicted by higher-risk behaviour on the part of their companions (e.g., parents, teachers) and walking alone on the street.

Therefore, it is important that they describe to their children what they are doing as they cross the road and engage them in the decision-making process as per O' Neal et al. (2021). Unless they do so, they may simply mirror what they see and not understand the difference between what they are attempting to do and what they observed the parent doing. Research (Morroginello et al., 2008) has indicated that children mostly map their own behaviour to parents' behaviour rather than their words. In addition, the older the children get the more they copy their parents' behaviour and the more they notice when parental safety practices are discrepant from what they are being taught. When these researchers compared the impact of parent practices and teaching about safety on children's current behaviours and their intended future behaviours when they reach adulthood it was best predicted by parents' practices. Therefore, it is important for parents to be aware that how they cross the road when they are with their children up to later adolescence is an invaluable opportunity to instil better road safety knowledge and enhance their perceptual ability to cross the road safely when on their own as per previous research (Tolmie et al., 1998; Tolmie et al., 2000).

When parents were asked to rate how they thought the children would behave on the road when crossing it was interesting to note that parents were underestimating their level of distraction and unsafe crossing. This may be related to their high rating for their children capability of crossing the road safely in this sample. While there will inevitably be some level of discrepancy between how a parent thinks their child will behave on the road and what a child does, possibly due to optimism bias, it highlights the need to further inform parents of the risks their children may be taking or be exposed to, by crossing in an unsafe manner. Furthermore, it has been noted that education may produce negative effects in that the increased knowledge that children exhibit can create a false sense of confidence amongst parents and children that their ability to interact with traffic is improving (Oxley, 2007). It was very interesting to note that parents reported significantly more unsafe crossing for their male children than their female children. Therefore, while they have a higher perception of risk for their female children, they also rated their male children as more likely to take more risks when crossing a road.

When asked about their planned protective behaviour, there was a lot of disparity between what the children have reported and how their parents think they would behave, in particular with regard to checking to make sure that traffic has stopped. This is interesting in light of the parents own reported behaviour indicating that they often wait until traffic has stopped, however their children observe differently. This behaviour, in combination with the parent's lower risk rating for danger when crossing at a pedestrian crossing when the light is red, but no traffic is coming, is problematic in educating children on how to observe the rules of pedestrian crossings to ensure they remain safe. As noted earlier, it is necessary when children are older to start the process of teaching them how to cross in places along a street other than a pedestrian crossing to increase their skill. However, when there is a pedestrian crossing with lights, it may send a conflicting message to children to break a traffic light. While the parent may be able to judge the gap accurately, children who do not judge the speed of a vehicle but the perceived distance, this may be more problematic. Further, established road safety messages delivered in schools teach children to wait until the light is green to cross and to always wait until all traffic has stopped to cross the road on green light. It was clear from the correlations that these parents are not fully aware of what their children are doing when out around the roads.

Parents and children were asked to rate how dangerous they perceived certain behaviours to be, such as playing on a footpath, ranging from 'always dangerous' to 'never dangerous'. It was interesting to note that both the children and parents' ratings for the safety of playing on footpaths in urban areas was quite high and may be indicative of a culture of using the outside footpaths as a play area when living in a cul-de-sac or estate, providing a false sense of safety. This was alluded to earlier when discussing dangerous play in Study 1 and would appear to lend some support to that earlier assortation that these conditions are not in fact dangerous. Overall, the perceptions of danger are very similar and may be indicative of a family culture of road safety.

Finally, when comparing the results for the responsibility belief scales, parents were asked to rate how they felt their child would respond to the responsibilities belief scale. It was interesting to see that the parents generally rated the children higher than the children rated themselves, in particular they felt they would disagree more to 'I do thing that are risky when out around the roads'. This would correspond to the impression that their children were either capable or very capable at crossing a road independently. Parents rated their perception of their female children's responsibility beliefs to be higher than that for their male children (correct as per Study 1 and Study 2). However, it was interesting to note that the parents thought their children would believe that drivers should be responsible for their safety, more than they themselves rated them to be responsible.

A key point to emphasise again is the parents' tendency to overestimate their children's safe behaviour while crossing and generally consider their children to be capable or very capable at using the road safely. This, most likely has come from the experience of their children walking independently to and from school, walking or playing around the roads frequently on their own or with friends (as observed in this sample) with no negative consequences. However, they most likely are unaware of the number of near miss events their children have. As set out in the literature, children do not have the same ability to judge gaps in traffic and make slower decisions to enter the traffic than adults, subsequently leaving them less time to cross safely. It is widely considered in the research that children are still developing these perceptual abilities until at least 14 years of age (O' Neal, 2018).

This needs to be framed in terms of the rate of serious injury and deaths in the 0- to 15-year-old population in Ireland (these figures relate just to public roads and not car parks or private property). Between 2014 and 2022, there were 56 fatalities aged 0-15 years and 852 seriously injured road users aged 0-15 years. Of the 908 children killed or seriously injured, half (51%) were pedestrians and almost a fifth (18%) were cyclists[1].

While this age band appears to be quite wide and the population in this sample were aged between 11 and 12 years, 6 in 10 of all children seriously injured were aged 10-15 years (60%), and over half of children killed (55%) were aged 10-15. Furthermore, as the majority of this sample was urban and demonstrated a high level of unsafe road crossing and near miss events, children were more likely to be injured on an urban road. Between 2014 and 2022, two in three (67%) child casualties were injured on urban roads with a speed limit of 60km/h or less and when analysing cyclist and pedestrian casualties during this nine-year time period, the proportion injured on urban roads increases to more than 8 in 10 (86%) casualties. Unsurprisingly, due to the density of the urban populations, Dublin and Cork saw the highest numbers of child casualties where three in ten (30%) child casualties among this age group occurred in Dublin and a further 10% occurred in Cork[1].

Parents have also considerably overestimated their children sense of self responsibility as seen in the ratings of how they thought their children would respond on the responsibility beliefs scale. In particular, parents in this study were very likely to rate their male children as very capable at crossing a road, however, they also considered them more likely than female children to engage in more unsafe road crossing and have lower responsibility beliefs. When assessing perceptions of risk, having a female child also increased their perception of risk. Therefore, in this sample, while they appear to be confident in their children's ability (based most likely on the lack of negative consequences to date), they are still more likely to rate their female children at a greater risk on the roads despite rating their male children as riskier road users than females. Further, even though they perceive their male children's road use as higher risk, parents were more likely to let their male children out around the roads on their own more often. On the other hand, they were more likely to accompany their female children. This is a theme consistent across the literature where males and females are socialised differently even in todays society.

These gender differences are also supported, not just in the academic literature, but also in the collision figures to date from Ireland where the proportions of male casualties were higher than female. According to the RSA report, each year since 2014, there have consistently been higher numbers of male child casualties than female child casualties (77% of male child casualties were vulnerable road users, compared to 60% of female casualties)[1].

Overall, this study has yielded results which are interesting as they remain consistent with the literature and highlight the need to further emphasise the importance of a family climate of road safety. The literature has found that parents are in a strong position to teach their children how to navigate the risks associated with road use across the span of their developing independence as pedestrians and cyclists. This has been demonstrated through the efficacy of training programmes involving parents and children aged between 7 and 12 years (Chapter 1). Study 2 has indicated that parents may be overestimating their children's ability to use the road safely as young pedestrians and have been observed by their children crossing the road in an unsafe manner. Analysis on the relationship between the parents observed behaviour and the child reported behaviour may also indicate the presence of modelling unsafe road behaviours. While an examination of how their peers may influence their behaviour was outside the scope of Study two, in Study 1 children were found to engage in more dangerous play and less planned protective behaviour when in the presence of other children, however, they were more likely to engage in unsafe crossing when on their own. Further to this, there was a positive impact on the presence of an adult on their behaviour when out and about the roads together. Therefore, this demonstrates that both parents and peers have an impact on how children behave but the presence of peers may have a greater impact when they are out around the roads together socialising and playing in this age group. Parents still have the ability to strengthen their children's road safe behaviour for when they are walking and crossing the road on their own through modelling good behaviour and actively educating their children when crossing the road together, how to identify gaps and identify hazards. This research supports the finding that parents do have a positive role to play in educating their children in pedestrian road safety through the older stages of primary school and further, to foster a family climate of road safety that will carry forward through their pedestrian and later driving experience.

1. RSA Child Casualties Report 2014 to 2022

Chapter 6 Summary Chapter

The aims of this research were to gain a better insight into the road use behaviour of Irish primary school children aged between 11 and 12 years. To do so required an assessment of their reported road use behaviour, their road safety beliefs and their perception of risk. This was followed for completeness by an assessment on how that relates to their parents' perception of risk and parents' perception of their child's road use behaviour. The following chapter will summarise the steps and key findings from each stage of this research.

Section 6.1 Summary of the validation of the Adolescent Road User Questionnaire (ARBQ)

Internationally, the main focus of road safety policy is directed at improving driving behaviour, however, a greater focus on pedestrian behaviour could help to reduce road deaths in two ways, one directly and the second indirectly. The first is through the application of age-appropriate evidence-based policies and education specific to this mode of road use. The second is through the creation of a culture or climate of road safe behaviour early in life as a pedestrian which will potentially continue throughout future modes of transport. For example, Şimşekoğlu (2015) noted when respondents were asked about their behaviours both as car drivers and as pedestrian, results indicated the tendency to take risks as a driver and as a pedestrian were highly correlated. This may indicate a risk-taking attitude that has developed at a younger age as a pedestrian could continue across the various modes of road use later in life. Therefore, developing an understanding of these early self-reported behaviours and attitudes is an essential step towards identifying areas, which may be possible to mediate with age-appropriate education and awareness at family and societal level.

To assess the behaviours of children aged between 11 and 12 years in Irish primary schools, an appropriate tool needed to be identified. While there are several well validated self-report pedestrian scales including the Scale of Pedestrian Behaviour (Moyano Díaz, 1997) and the Pedestrian Behaviour Scale (PBS), these were not validated for use in the age population in this research. Therefore, the Adolescent Road-User Behaviour Questionnaire (ARBQ: Elliott & Baughan, 2004) was selected. Like the PBS, this is a self-report questionnaire designed to measures the on-road behaviour of adolescents as pedestrians. It also includes questions on a small number of behaviours, such as cycling, skateboarding and rollerblading on the road (Elliott, 2004; Elliott & Baughan, 2004). The factor structure of the ARBQ was based on an exploration of 2433 English students aged between 11 and 16 years old using a 43-item questionnaire. The analysis produced three reliable factors: 'Unsafe Crossing Behaviour', 'Dangerous Playing in the Road' and 'Planned Protective Behaviour'. Importantly, a shortened 21 item ARBQ was also developed demonstrating good internal reliability. This shorter scale would be preferable for use in the current age group. The psychometric properties of the ARBQ have to date had been investigated in New Zealand (Sullman & Mann, 2009), Spain (Sullman et al., 2011) Belgium (Sullman et al., 2012) and Iran (Nabipour et al., 2015). Previous research using confirmatory factor analysis (CFA) has shown that the three-factor model did not satisfactorily fit the data when using the 43-item version, but that an acceptable fit was obtained for the 21-item scale in Belgium, Spain and Iran. One study in New Zealand produced a 19-item version of the scale using exploratory factor analysis (Sullman & Mann, 2009). Confirmatory factor analysis (CFA) was used to investigate whether the self-reported data from 11- to 12-year-olds in Ireland, complied with the previously established factor structure identified by Elliott and Baughan (2004) through Amos 27 using maximum likelihood (ML) estimation procedures. The sample size of 985 was deemed sufficiently large to give adequate power for the statistical analyses, as the recommendation is to use a sample that is ten to twenty times the number of parameters to be estimated in the confirmatory analyses (Lei & Wu, 2007).

The original 43 items were reduced to 41 items in the current research, to reflect the age of the participants and the appropriateness of the questions. Two models were constructed in the process of validating the 41-item. Model 1 demonstrated a poor fit across most indices, but the lack of satisfactory goodness of fit for the 41-item model was consistent with previous studies on the 43 item ARBQ, by Sullman et al. (2011) in Spain and Sullman et al. (2012) in Belgium. An examination of the modification indices identified several problem pairs and by allowing 9 error pairs to be correlated a second model was produced which did demonstrate some improvement overall, but still did not have satisfactory fit indices. The factor loadings remained similar to Model 1. Theoretically, a third model should be considered, however, as the literature has consistently been unable to provide support for the larger 42 to 43 item ARBQ, it would seem redundant. In contrast, the literature had been able to find support for the shorter item ARBQ ranging from 19 (Sulleman & Mann, 2009) to

21 items (Nabipour et al. ,2015; Sullman et al., 2011, 2012; Elliott and Baughan, 2004). The shorter version is also more likely to be utilised as a tool to examine self-reported behaviour in the primary school population aged 11 to 12 years. Therefore, the next step involved determining the suitability of a model based on 21 items. Consistent with the approach previously adopted of removing items deemed inappropriate, one item that was part of the original 21 was also removed: "Play 'chicken' by lying down in the road and waiting for cars to come along" resulting in a 20 item scale to be tested. The resultant Model 3 demonstrated a poor fit across most indices, but these results were again consistent with previous literature (Nabipour et al. ,2015; Sullman et al., 2011, 2012) which found it necessary to respecify the model and let a number of error pairs co-vary. Model 4 was respecified with 7 pairs of errors covaried, consistent with previous studies (Nabipour et al. ,2015; Sullman et al., 2011, 2012). While it could be deemed a satisfactory fit according to the Hu and Bentler (1999) two-index strategy and the stronger values across all indices compared to the other three models, the very restricted age range in this sample 11-12 years, compared to other studies which included ages ranging from 11 to 19 years may have resulted in lower than desired indices values., Therefore, it was deemed prudent to develop a version of the ARBQ more suitable for use in primary school children aged between 11 and 12 years.

Prior to conducting the exploratory factor analysis (EFA), the original sample was split to facilitate an exploration of the factor structure on one half and a confirmation of any resultant model on the other. This was done to control for common method bias (CMB) and to limit the impact of multiple model specifications in CFA. In line with the original authors and previous studies (Eliott & Baun, 2004; Sullman & Mann, 2009; Nabipour et al., 2015) to explore the factor structure of the ARBQ, the 41 behaviour items were subjected to Principal Axis Factoring (PAF) with varimax rotations. A three-factor solution accounted for 32.3% of the variance similar to the 34.6% found in the UK (Eliott & Baun, 2004) and 32.1% in New Zealand (Sullman & Mann, 2009). The 17 items loading onto Factor 1 were summed to produce a composite scale called 'Unsafe Road Crossing Behaviour' with the Cronbach's Alpha = 0.86. The six items loading onto Factor 2 were summed to produce a composite scale called "Planned Protective Behaviour" with an internal reliability of .83. The seven items loading onto Factor 3 were summed to produce a composite scale called "Dangerous Play on the Road". This scale demonstrated acceptable reliability with Cronbach's Alpha = .76. As the aim was to provide a shorter scale for use in Irish primary schools, two iterations of a short scale were produced with a final 20 item scale accounting for was 47.99% of the variance. To verify the factor structure found in the Irish sample, a CFA on the second subset of the full dataset was run. As per the previous CFA on the 41-item scale, two models were constructed with the final model demonstrating a good model fit .The reliability for each sub scale was high (unsafe crossing .83; planned protective behaviour = .84; dangerous play = .72) indicating a reliable scale with discriminant validity suitable for use in the 11 to 12 year old population.

Section 6.2 Summary of Reported Road Use Behaviours in Children Aged 11 to 12 years

A total of 1,100 Adolescent Road User Questionnaires (ARBQ) were fully completed across 42 primary schools in the republic of Ireland. Primary school in Ireland has 8 class groups: Junior, Senior, First, Second, Third, Fourth, Fifth and Sixth class. Children typically start between the ages of 4 and 5 but must have started school by the age of 5. This sample was recruited from sixth class only and the age was restricted to 11- and 12-year-olds. While there may be children who are 13 by the time they complete primary school, the data collection was at the start of the school year and ran until the end of March. As the number of children aged 13 was predicted to be very low, it was decided to exclude them from the study. This also kept the 11 to 12 age band comparable to previous studies using the ARBQ who used 11-12, 13-14, 15-16 and 16+ groupings.

To assess the behaviours reported by the children, frequencies of individual Likert items were calculated and examined along with composite scores for each of the three factors (Unsafe Crossing, Planned Protective Behaviour and Dangerous Play). Consistent with the previous studies examining road use behaviour through the ARBQ, these composite scales were created for each factor from the shortened 21 item scale. Apart from the ARBQ which collected information on their behaviour, children were asked to provide information on their traffic exposure, beliefs and demographic information. This chapter investigated the children's reported road use behaviour, across the three factors according to gender, location and education to that observed in the UK, Belgium, Spain, New Zealand, Iran and China. The final step was to create a HLM model for each factor to account for clustering at school and location level. These models extended the demographic analysis in the international comparisons to include the exposure and beliefs data.

Section 6.2.1 Brief Summary of Reported Road Use Behaviours

An examination of each of the responses on the full 41 items scale was conducted to gain a better insight into the full range of road use behaviours in the current sample. It was interesting to note a high level of distraction while crossing the road, either through use of a mobile phone or by crossing with friends and forgetting to observe the traffic. There was a high level of risky road crossing behaviours identified which demonstrated their propensity to see a gap in traffic and go for it, crossing from between parked cars or behind stationary vehicles, crossing when they do not have a good line of sight like on a hill and not bothering to walk to a nearby pedestrian crossing all had similarly high frequency of occurrence. There was also a surprisingly high frequency reports for playing chicken with cars and deliberately running across the road without looking for a dare. These behaviours need to be considered in the high level of self-reported near miss experiences with traffic (84%). It was also interesting to note that 65% of the children reported cars travelling faster than they thought when trying to cross the road which aligned with the research that identified a deficit in children aged 11 to 12 years perceptual ability. There was evidence of some compliance with standard rules of the road such as looking both ways before crossing, but a poor reported frequency of other planned protective behaviours. Each of these behaviours were discussed in depth considering the relevant literature.

A comparison of the means of these behaviours across the other countries who also used the ARBQ to assess their young adolescent populations behaviour was conducted. The top three and lowest five were fairly consistent across each, in particular, across the European countries. The most frequently reported behaviours were those that demonstrated desirable road safety behaviour such as 'Look both ways before crossing' (rank = 1), 'Check to make sure traffic completely stopped before cross at pedestrian lights' (rank = 2) and 'Keep looking and listening for traffic' (rank =3). The first and second highest ranked questions were the same across the UK, Spain, Belgium and New Zealand. Only 'Look both ways before crossing' was the same across all countries. In general, the majority of the same behaviours appeared in the top ten rankings across the studies with regard to pedestrian behaviour. The five least frequently reported behaviours were very similar across all countries including Ireland, despite the difference in the age ranges across studies and included extreme risk behaviours such as holding onto moving vehicles, running across the road for a dare or playing chicken with the traffic.

Section 6.2.2 Brief Summary of ANOVA Results on the Three Factors

The analysis of variance (ANOVA) presented a consistent theme across three ARBQ behaviours assessed. There were significant gender differences across two scales with males self-reporting more risky road crossing behaviour and less planned protective behaviour than females. There were no significant gender differences for dangerous playing on the road. Children with prior road safety education in schools reported more risky road crossing and more dangerous play but on the other hand, more planned protective behaviour. The location across the three sets of analysis consistently had the strongest impact. Children in rural schools reported less risky road crossing, less dangerous play on the road and more planned behaviour than children in either the small or large urban areas. These data were interpreted according to the literature and social cognitive theories relevant to the latent constructs being assessed.

Section 6.2.3 Brief Summary of How the ANOVA Results Compared to the International studies.

For the purpose of this comparison, six studies with demographic analysis on the ARBQ behaviours were reviewed. It should be noted that the age of publication of these studies range from 2004 to 2019. This may have an impact on some behaviours, such as the increased use of mobile phones in the younger populations from older to newer studies. There are cultural differences to consider such as the more individualistic societies in Ireland, the UK, Spain, Belgium and New Zealand compared to the more collectivist societies of Iran and China. Despite these obvious limitations, there was a similarity observed in the behaviours across each study indicating that some factors remain stable over time and across nationalities. Age was not assessed in the Irish sample.

Gender: Gender differences remained relatively stable across each study with males more likely to engage in unsafe crossing than females in Ireland, the UK, Belgium, Spain and China. There were no gender differences in unsafe crossing in New Zealand or Iran. Planned protective behaviour was higher in females in Ireland similar to the UK and Chinese studies, but different to Iran where males reported more planned protective behaviour. No gender differences were reported in Belgium, Spain, New Zealand. For dangerous play on the road, the Irish sample found no gender differences which was in contrast to males performing this behaviour more often in the UK, Spain, Belgium, New Zealand, Iran and China. However, this needs to be interpreted with caution as the items in the Irish ‘dangerous play’ scale were comprised of less ‘high risk’ items included in the other studies such as playing chicken by lying on the road or running at the traffic and holding onto moving vehicles while on bikes and scooter. These higher risk items are more likely to occur in older adolescents rather than the younger adolescent cohort in this sample.

School Location: The behaviour in rural versus small and large urban locations was not collected in all studies (Spain). Where it was assessed, Belgium and New Zealand reported non-significant differences due to school location across all three behaviour scales. Adolescents in Iran found no difference in behaviour by school location for unsafe crossing whereas those in the Chinese study reported adolescents in rural areas performed more unsafe crossing than those in large urban areas. In contrast to this, Ireland, similar to the UK, children in rural areas were less likely to engage in unsafe crossing than those in large urban areas. Unlike the UK, Ireland also reported that those in rural schools were also significantly less like to perform unsafe crossing behaviours than those in small urban area. There was no difference depending on whether the school was in a large versus small urban area. Planned protective behaviour was also different across the studies. In the Iranian and Chinese samples, those in large urban areas were more likely to engage in planned protective behaviour than those in small urban or rural areas. In contrast both the UK and Ireland found overall, those in rural areas were more likely to engage in planned protective behaviour than those in an urban setting, with no difference whether in a small or large urban area. The UK had a significant interaction with age and the school location with younger children aged 11 to 12 years behaving more safely in rural, small urban and large urban areas than their older counterparts. In Ireland, the planned protective behaviour needs to be interpreted in light of the significant interaction with gender where females who attended rural and small urban schools reported significantly more planned protective behaviour than males but significantly less than males when attending large urban schools. Males who attended small urban schools reported significantly less planned protective behaviour than those who attended a large urban school. By contrast, females who attended small urban schools reported significantly more planned protective behaviour than when attending a large urban school. Dangerous play on the road was also different across the various studies. In Iran, China and the UK, there was more dangerous playing on the road reported in rural compared to large and small urban areas. By contrast, in Ireland, children in rural schools were less likely to report dangerous play compared to those in small and large urban areas.

Overall, the Irish data lends further support to the validations in the previous countries on the ARBQ and use of the data to assess behaviour in young adolescents. In particular, the gender differences in unsafe crossing and planned protective behaviour with males taking more risks and engaging in less planned protective behaviour than females.

Section 6.2.4 Brief Summary of HLM models for the Three Factors

As there were 1,100 children aged between 11 and 12 years nested withing 42 schools across Ireland, Hierarchical Linear Modelling (HLM) was deemed appropriate for the analysis as it identifies the relationship between predictor and outcome variables by taking both level-1 and level-2 regression relationships into account. In contexts where data are nested (e.g., in this study, students nested within schools) it is important that the nesting be accounted for in the model to avoid misrepresenting the effect. A series of two-level HLM regression models were fitted for each of the three behaviour outcomes. The steps involved follow a general "build-up" strategy for model testing (Heck et al., 2014; Tabachnick & Fidell, 2013) starting with an unconditional means model and progressing through random-coefficient models, random intercept with means-as-outcomes model and finally intercepts and slopes-as-outcomes model to assess any interactions between level 1 and level 2 predictors (Bryk & Raudenbush 1992).

A series of 16 hypotheses were assessed for each factor which assessed the impact of demographic variables, along with traffic exposure and responsibility beliefs.

Unsafe Crossing: Overall, the final model (Model 6) provided the most sense theoretically, as it captured most of the strongest predictors that were observed across each model and highlighted some important interactions. At Level 1, males were more likely to report unsafe crossing, the negative impact of greater frequency of being on the roads on their own in urban school locations, the experience of a near miss on the road in both urban and rural school settings and finally, higher responsibility beliefs resulted in less unsafe crossing on the road. There was an observed interaction where higher responsibility beliefs resulted in lower unsafe crossing for females only. The location of the school indicated that those in urban schools were more likely to engage in unsafe crossing. There was an unexpected outcome across some of the models where children who had experienced RSA education programmes in their school, reported more unsafe crossing. It may have been assumed that those children who had RSA education demonstrated differences in their road safety beliefs. However, there was no cross-level interaction between schools with and without education and responsibility beliefs indicating that there was no impact at school level. However, analysis indicated a significant interaction between location and education where education was associated with greater unsafe crossing in urban schools only. As education failed to be a significant predictor in Model 5 once responsibility beliefs were included, and location was consistently the strongest predictor, it was concluded that the strongest influence on unsafe crossing was the urban location in which children both attend school and live. Therefore, based on the final model interactions and the strongest predictors across each iteration, unsafe crossing is more negatively impacted by the urban environment in which they attend school, live and socialise and strength of responsibility beliefs rather than education in primary school. Key areas which are very important to highlight are the strong predictive ability of previous near miss experiences, the positive impact of higher responsibility beliefs and the higher frequency with being around roads with adults reducing unsafe crossing. These finding are discussed in considerable detail with reference to previous literature and theoretical constructs underpinning the behaviours.

Planned Protective Behaviour: Overall, the final Model 6 provided the most sense theoretically as it retained the strongest predictors that were observed across each model. The variables that remained constant across each iteration were, being female, the positive impact of higher levels of exposure to the road environment, the positive impact of being accompanied by an adult and the positive impact of holding higher responsibility beliefs. Negative predictors included an experience of a near miss on the road which was more likely to predict less planned protective behaviour. The location of the school indicated that those in rural schools, in particular females, were more likely to engage in planned protective behaviour than children of either gender in urban schools. Therefore, in this study, planned protective behaviour on the road was more impacted by the environment in which they attend school and live, the level and type of accompaniment (negative with friends, positive with adults) and having stronger responsibility beliefs, rather than education at primary school level. These finding are discussed in detail with reference to previous literature and theoretical constructs underpinning the behaviours.

Dangerous Play on the Road: Overall, the final model (Model 6) provided the most sense theoretically as it captured the strongest predictors that were observed across each model. The variables that remained constant across each iteration until the final model, were the impact of higher levels of exposure to the road environment, the negative impact of greater frequency of being on the roads or with friends and the positive impact of being accompanied by a parent. Having an experience of a near miss on the road was likely to predict more dangerous play on the road, while having higher responsibility beliefs resulted in less dangerous play on the road. The location of the school indicated that those in urban schools were more likely to engage in dangerous play on the road. It should be further noted that children in urban schools with higher levels of exposure demonstrated significantly higher levels of dangerous play on the road. Those children with higher levels of responsibility beliefs demonstrated lower levels of dangerous play on the road in urban areas than those in rural locations. There was an unexpected outcome across some of the models where children who had experienced RSA education programmes in their school, reported more dangerous play on the roads as in unsafe crossing. It may have been assumed that those children who had RSA education demonstrated differences in their road safety beliefs. However, there was no cross-level interaction between schools with and without education and responsibility beliefs as observed with the location, indicating that there was no impact of education on beliefs at school level. On the other hand, a same level interaction demonstrated a significant interaction between school location and education where education was only a significant predictor of dangerous play in urban schools only. Education failed to reach significance in Model 5 once responsibility beliefs were included, as in unsafe crossing. Further, the significant interaction between responsibility beliefs and location needs to be considered. Therefore, just as in the unsafe crossing factor, it is suggested that the strength of the urban location as a predictor is driving the observed relationship between education and dangerous play. Separate to this final model, experience of a near miss interacted with levels of exposure indicating that exposure was only a significant predictor of dangerous play when recording a near miss experience Therefore, it is clear in this study, dangerous play on the road is more impacted by the urban environment in which they attend school, live and socialise and their responsibility beliefs than education at primary school level. These finding are discussed in considerable detail with reference to previous literature and theoretical constructs underpinning the behaviours.

Overall, the presence of the cross-level interactions clearly demonstrated the efficacy of running these analyses through HLM rather than Hierarchical linear regression due to the obvious impact of clustering at school level.

Section 6.3 Summary of Parent and Child Matched Pairs Study

This chapter reports on the self-reported behaviour of 125 matched pairs of parent and child with a view to assessing factors that influence risk perceptions within the parent-child dyad based on previous research and their own reported road use behaviour. The study was designed to enable an investigation into the degree to which self-reported behaviour by the children correspond to the self-reported behaviour of parents while in the company of their children to assess the potential impact of parental modelling and the parents rating of how they expect their children behave when using the road. The questions on road use behaviour were extracted from the ARBQ (Elliott & Baughan,2004) and were classified as 'Unsafe Crossing' and 'Planned Protective Behaviour'. The factor 'Dangerous Play' was excluded as it would not be relevant to parents. While it is appreciated that the term 'unsafe crossing' may not be appropriate to the level of expertise the parents have in road crossing, it is termed so to avoid confusion when making comparisons. The assessment of risk was based on an extended conceptual framework first put forward by Cloutier et al. (2011). According to the framework, there are four main themes: demography, environment, family mobility and cognitive elements. There have been amendments made to the content under each of the themes to better reflect this current study while still maintaining the integrity of the original model. There is also an extension of the model to include a behavioural element (self-reported unsafe crossing) due to the strength of these behaviours observed in Study 1 of this research. In accordance with the Theory of Planned Behaviour and social learning, past behaviour is a strong predictor of future behaviour and may have an impact on the development of risk perception. The majority of the parents in this sample were female, urban dwellers, with more than half having third level education, with the majority having either 2 or 3 children in their home. Less than fifteen percent lived in a countryside setting. There were high levels of exposure as over half of the parents indicated they walked for either pleasure, work or school between 4 and 7 days a week. There was an experience either themselves or a family member of being involved in a pedestrian RTC, although none required overnight stay. There was a fairly even distribution of male to female children with the majority of the males being aged 12 years. Therefore, this sample is primarily reflective of an urban family with high levels of exposure traffic.

Section 6.3.1 Brief Summary of Parents Predicted Unsafe Crossing

Gender was the strongest predictor of unsafe crossing indicating that females demonstrated significantly lower unsafe crossing than males. This remains consistent with literature demonstrating that in general males take more risks in traffic than females. While age was also a significant predictor it accounted for much less of the variance than gender (3.2%) but indicated that as age increased so did unsafe crossing. The most interesting finding was that parents who felt they could control the risks in an urban environment also reported more unsafe crossing. Those who had a personal history of an RTC in the 5 years previous and reported more planned protective behaviour, reported lower unsafe crossing.

Section 6.3.2 Brief Summary of Parents Predicted Perception of Risk for their Children as Pedestrians

Overall, these results indicate a consistency with what is demonstrated in the literature. Females demonstrated higher road safety risk consistent with the literature which previously investigated child road safety risk perception. Having a higher risk rating for the safety of traffic in the area was also significantly increased the perception of risk. The gender of the child was a significant predictor, with parents of female children rating road risks as higher than for males. Parents who had a family history of an RTC or experienced an RTC in the past 5 years themselves also rated the risk for their children higher. Finally, previous higher unsafe crossing also increased the perception of road risk for their children.

Section 6.3.3 Brief Summary of Children’s Predicted Unsafe Crossing

The strongest predictor accounting for the greatest amount of variance on its own was responsibility beliefs where the higher responsibility beliefs, the lower the unsafe crossing reported. The second strongest predictor was birth order indicating that children who are higher in birth order demonstrate more unsafe crossing. The third highest was near -miss experience with having at least one increasing the reported unsafe crossing. The next was gender where males demonstrated higher reported unsafe crossing than females. The final significant predictor was the frequency of walking around the town on their own. Interestingly, planned protective behaviour was a non-significant predictor of their unsafe crossing. However, the results remain consistent with that of the Study 1 where males, having a history of a near miss and higher frequency of walking on their own were all significant predictors resulting in more unsafe crossing. The variable item of interest that was not tested before was birth order. This may be influenced by having older siblings.

Section 6.3.4 Brief Summary of Children's Predicted Perception of Risk as Pedestrians

Overall, while the model highlighted some important factors which could help identify predictors of risk perception such as the exposure to traffic, particularly in an urban location as the majority of this sample resided. Being surrounded by heavy traffic while walking to school every day was a significant predictor of lower risk perception. Having older siblings also decreased the perception of risk. The child's high reported unsafe crossing increased the perception of risk, however, the experience of a near miss decreased the perception of risk.

Section 6.3.5 Brief Summary of Comparison of Parent and Child Behaviours and Risk Ratings

When a comparison was made initially for the self- reported unsafe crossing by the parents and by their children, there appeared to be a higher degree of unsafe crossing observed in the children in areas around distraction and higher risk behaviours such as running across the road because they were in a hurry, crossing from between parked cars and having to turn back to avoid traffic. However, sometimes people are unaware of their behaviour as it has become habituated or, in this instance they may be liable to desirability responding. To control for this, the children were asked to rate what they 'observed' their parents doing when crossing the roads with them. This is a more powerful indicator of the actual behaviour. When these two sets of self-reports were compared, there was a closer alignment between what the children were actually doing and what they observed their parents doing. Therefore, there is quite a strong relationship observed which may provide support for the role of parental modelling of road crossing behaviour.

When parents were asked to rate how they thought the children would behave on the road when crossing, it was interesting to note that parents were underestimating their level of distraction and unsafe crossing. This may be related to her high rating for their children's capability of crossing the road safely in this sample. While there will inevitably be some level of discrepancy between how a parent thinks their child will behave on the road and what a child does, possibly due to optimism bias, it highlights the need to further inform parents of the risks their children may be taking or be exposed to, by crossing in an unsafe manner. Parents rated their male children as engaging in higher unsafe crossing than their female children. When asked about their planned protective behaviour, there was a lot of disparity between what the children have reported and how their parents think they would behave, in particular around checking to make sure that traffic has stopped. It was clear from the correlations that these parents are not fully aware of what their children are doing when out around the roads. Parents and children were asked to rate how dangerous they perceived certain behaviours to be, such as playing on a footpath, ranging from 'always dangerous' to 'never dangerous'. It was interesting to note that both the children and parents ratings for the safety of playing on footpaths in urban areas was quite high and may be indicative of a culture of using the outside footpaths as a play area when living in a cul-de-sac or estate, providing a false sense of safety. This was alluded to earlier when discussing dangerous play in Study 1 and would appear to lend some support to that earlier assertation that these conditions are not in fact perceived as dangerous. Overall, the perceptions of danger are very similar between parent and child and may be indicative of a family culture of road safety.

Finally, when comparing the results for the responsibility belief scales, parents were asked to rate how they felt their child would respond to the responsibilities belief scale. It was interesting to see that the parents generally rated the children higher than the children rated themselves, in particular they felt they would disagree more to 'I do thing that are risky when out around the roads'. This would correspond to the impression that their children were either capable or very capable at crossing a road independently. Parents rated their perception of their female children's responsibility beliefs to be higher than that for their male children. However, it was interesting to note that the parents thought their children would believe that drivers should be responsible for their safety, more than they themselves rated.

Chapter 7 General Discussion

The aims of this study were to develop a valid and reliable self-report road safety tool for children aged between 11 and 12 years in Ireland and to gain a better insight into the road use behaviour and beliefs of Irish primary school children of this age. It also aimed to assess these children's perception of risk on the roads and how parents perceive their child's road use behaviour and road risk. At the end of each chapter, there is a discussion on how the findings relate to the literature. This general discussion sets the results in context and identifies how the key findings have contributed to the literature, theory, practical implications and recommendations for future research and practice.

Section 7.1 The 20 Item Adolescent Road User Behaviour Questionnaire

A key objective of this study was to provide the funding body for this research (RSA) with an age-appropriate tool to gather the self-reported pedestrian behaviour in sixth class primary school children (11 and 12 years of age). This large-scale two-phase research has developed a valid and reliable 20 item self-report pedestrian behaviour scale from the larger 42 item ARBQ created by Elliott and Baughan (2004) for use on 11 to-12-year-olds in Ireland.

While the ARBQ (Elliott & Baughan, 2004) was originally validated for use in a wider age group from 11 to 16 years, the key difference in this study was the validation for use in just 11- to 12-year-olds. While the testing of the scale remained mostly consistent with that of the original and subsequent ARBQ studies cited in this research, there were nuances that may have been attributed to the restricted younger age group. Most specifically, the order of the factors changed to reflect more emphasis on planned protective behaviour than dangerous play in this cohort and the difference in the types of dangerous play they engaged in. To help interpret this, consideration needs to be given to the original concepts of 'violations' and 'errors' (Reason et al. ,1990) which underpinned the development of pedestrian surveys including the ARBQ. There are important differentiations between violations (intentional) and mistakes (unintentional) as each have different psychological origins. Violations or intentional transgressions are defined as deliberate deviations from practices and involve social and motivational factors, whereas errors (slips, lapses, and mistakes) may be accounted for by the information-processing characteristics of the individual. Lapses specifically have been defined as acts of omission putting the individual in a situation of personal endangerment but with no intent to take a risk (Twisk et al. 2015).

Similar to Elliott and Baughan (2004), in the present study, some violations loaded onto Factor 1 (unsafe road crossing) and some loaded on Factor 3 (dangerous playing in the road). It should be noted that as per the original ARBQ study, the violations relating to 'unsafe road crossing' and 'dangerous playing' in the road are qualitatively different. For example, some 'unsafe crossing' violations could be perceived as being on the lower end of the scale designed to protect the younger, unskilled, or inexperienced road users (e.g., not using a nearby crossing). However, the items loading on the 'dangerous playing in the road' factor comprised behaviours that could be considered as ''extremely risky'', including violations such as playing chicken on the road by deliberately running out in front of traffic.

As in the Elliott and Baughan (2004) research, within this study, 'unsafe crossing' contained items or behaviours that could be classified as errors and violations. Young adolescents (11 to 12) may not necessarily perceive road crossing errors (crossing while distracted) as being dangerous because they may believe they have the ability to avoid the negative consequences of their behaviour. To support this suggestion, Twisk et al. (2015) noted errors are unintentional deviations from safe practices and reflect inadequate skills (inexperience), or temporarily adverse states (fatigue, distraction), whereas violations are deliberate deviations from safe practices (such deliberately violating a red light or in this study, running across the road for a dare). Apart from these more deliberate behaviours, this age cohort may also not understand that certain violations such as crossing between parked cars are dangerous, as they overestimate their road crossing skills while deviating from recognised safe crossing rules. They are also inexperienced at recognising unmaterialised hazards. These types of violations and errors may be related to research discussed in Chapter 1, indicating that this age cohort may not be aware of the consequences due to their less developed attentional capacities, which results in slower decision making and less safe time for them to cross the gap safely (Tapiro et al., 2018) than older adolescents. Further, when it comes to crossing from behind parked cars, they have poorer ability at identifying unmaterialised hazards (Borowsky & Oron-Gilad, 2013; Meir et al., 2013; 2015;2015a) than older adolescents and adults.

As in the original study, ‘Planned Protective Behaviour’ contained items relating to the use of safety clothing (reflective vets and helmets) and lights on a bicycle when dark. Within this age group, the use of these items may be due in part to the parents, who may not have provided these items or enforce their use, even if for example, a cycle helmet is provided. Furthermore, children in this age group may not be out after dark too often on their own. However, these behaviours could be deemed as violations, although there are no specific rules that mandate the use of such items in Ireland. Twisk et al. (2015) suggested that dangerous play, lack of protective behaviour, and violations all reflect a *more or less* intentional action, whereas errors reflect an unintentional deviation from safe practices. However, they also suggested in the age groups 12 to 13 and 14 to 16, a lack of planned protective behaviours was not motivated by traffic rules, but by a person’s lack of awareness of hazards. That would be a valid consideration in the current 11 to 12-year-old age category as per the research on their poorer understanding of hazards. Interestingly, Twisk et al. (2015) results indicated that in the younger age group, ‘errors’, ‘dangerous play’, and ‘lack of protective behaviour’ predicted self-reported crashes; for the older age group only ‘errors’ were predictive of self-reported crashes and near crashes. While this study did not collect information on previous crashes, it did collect self-reported reported near miss events. There was a high rate of these (84%) recorded, thus suggesting the errors, dangerous play and lack of planned protective behaviour demonstrated in this sample, may predict negative outcomes.

The information gathered through this scale in the current research has provided a wealth of previously unknown information around the self-reported road use behaviours in Irish children across three domains, ‘Unsafe Crossing’, ‘Planned Protective Behaviour’ and ‘Dangerous Play’ on the road. It can be used as a predictor for negative outcomes due to the combination of errors and violations which can be related to the cognitive abilities of children aged 11 to 12 years. From a practical perspective, as violations are associated with attitudes and motivations which in turn are influenced by the social context, they may only be addressed through a change in attitudes which will take longer to influence over time. Mistakes (errors) on the other hand, may be due to failures of cognitive skills and so should be impacted by educational campaigns and training courses. Ideally, the RSA would administer this shortened 20 item scale to a nationally representative sample on a periodic basis to chart any changes in young adolescent behaviour over time due to their participation in school road safety education or wider nationally led interventions on child pedestrian behaviour. The RSA can also use it to provide a benchmark for future evaluations on the effectiveness of road safety interventions in schools. While this 20-item scale has been validated in Ireland, it can be employed in other countries specifically for use in the 11 to 12 year old age-group, as it more accurately reflects their road use behaviour rather than the inclusion of items which are more relevant to the older adolescents. The inclusion of these other more high-risk activities may mask important nuances relevant to the children of the younger age group. As 11- to 12-year-olds are just beginning their use as independent road users, this is a very important factor to consider to ensure accurate educational messages specific to this cohort.

Section 7.2 Self-Reported Road User Behaviour

An investigation into the behaviour of these children has demonstrated that their behaviour was similar with the general pattern of results in the previous studies in the UK, Spain, Belgium, New Zealand, Iran and China for unsafe crossing and planned protective behaviour, with young males in general behaving riskier on the road and engaging in less planned protective behaviour. The main difference lay in the domain of dangerous play where, in the Irish sample, as children were younger, the questions relating to the dangerous play factor consisted of less risky behaviours such as those around socialising on the road rather than extreme risk like playing chicken with the traffic. This is an important differentiation to make as it is reflective of the more seemingly benign dangerous play which can still result in devastating consequences for this age group. Therefore, rather than focusing on extreme behaviours as a definition of dangerous play, the day-to-day behaviours of children living and socialising, in particular, in urban areas, is placing them at greater risk.

While the relationship with gender and greater road risk is well recognised across the literature and road casualty statistics, this research has identified the more complex factors that are combining to increase the unsafe crossing and dangerous play in this age group in Ireland. Initially, using an ANOVA technique, it was determined that the unsafe crossing in young males could be attributed to greater exposure in urban areas, and based on the literature due to lack of awareness of their poor hazard perception and deficits in attentional capacity. This may also be impacted through unrealistic optimism that they are skilled enough to avoid more serious negative consequences. However, the impact of friends and responsibility beliefs were not assessed at this stage. When included in the statistical modelling the results indicated it may be more complex than that and be a reflection of their elevated risk taking, both when on their own and in particular in the presence of peers and perpetuated through the lack of negative consequences, unrealistic optimism and lower road safety responsibility beliefs. However, the gender difference in unsafe crossing may also be influenced by young males' greater experience of road crossing through being around the roads more frequently on their own. In this sample, females were statistically less likely to be out on their own and as such would be offered less opportunity to cross unsupervised. This level of experience in young males may have resulted in greater confidence on the roads and willingness, based on previous experience of no negative consequences, to take more risks when crossing. Much of the research on child pedestrian safety discusses the importance of exposure to traffic and acquiring skills in real-traffic environments (Zeedyk & Kelly, 2003), particularly developing an awareness of traffic and learning fundamental road safety practices, initially under adult supervision and leading to independent travel. Oakley (2007) found that exposure to traffic, particularly the amount of independent travel is associated with road-crossing skill. It was interesting to note in Study 2 that walking everyday to school at rush hour decreased the child's perception of risk. This would support the assumption that greater exposure increases confidence and lower their risk perception. However, it may unrealistically raise their confidence over their skill level, increasing their risk when crossing the road. The only way to determine if this greater level of experience is driving the gender difference would be to use a sample matched for road exposure and run the same analysis. Overall, when examining the road crossing behaviours in this sample, the difference in the results of the first ANOVA analysis and the HLM analysis has demonstrated how important it is to use more sophisticated HLM to fully assess potential influences on road use behaviour. None of the previous ARBQ studies ran this level of analysis therefore, this study provides a deeper understanding of the reported behaviour.

In the second study on the smaller sample of children (N = 125), there was additional support for the findings on unsafe crossing to that observed in the HLM modelling.

Responsibility beliefs were the strongest predictor resulting in lower unsafe crossing when responsibility beliefs were high. While being accompanied by friends was not significant in the second study, the birth order of the child was, demonstrating the greater number of older siblings the child had the greater the level of unsafe crossing. This may indicate the presence of an alternative form of peer influences, this time coming from older siblings and their friends. Consistent with the HLM model, being male increased unsafe crossing, as did the experience of a near miss event and being out around the roads on their own. Therefore, two separate sets of analyses on children aged between 11 and 12 in Ireland demonstrate a complex pattern of predictors for unsafe crossing which include road safety responsibility beliefs, the impact of peer/sibling influence, previous behaviour such as near miss events, frequency of being out alone in urban environments and gender, with males consistently taking more risks.

For dangerous play, the results were very similar to what was observed in the unsafe crossing behaviour, with the exception of the even stronger impact of being around the roads with friends rather than being alone. This of course would make sense theoretically as play would normally involve more than one person. However, there is a consistently strong message across each of the behaviours where the urban location results in higher risk-taking actives due to the amount of time they spend on the road travelling to and from school and socialising. The main difference here theoretically between unsafe crossing and dangerous play would be the perceived difference in intentionality with these behaviours rather than being lapses or errors. However, as noted previously, the items that contribute to dangerous play in this sample related more frequently to socialising around the roads and the resultant distraction associated with that, rather than primarily high-risk actives such as playing chicken or running across the road for a dare as in other studies with older adolescents included.

In the unsafe crossing model, it was considered that many of the instances underlying unsafe crossing may be due to their distraction by being accompanied by friends, mobile phone use, thinking about other things while crossing, combined with higher risk taking as explained by the Dual Systems Theory. While those are still relevant arguments here, there is a much stronger indication on the influence of peers and how living in an area with a high volume of traffic, most likely in urban areas in an estate or cul-de-sac, has resulted in their lowering of perceived risk and treating the road like an extension of their garden or similar safe recreational area. This may also relate to the parents' lower perception of risk due to the habituation of living in a high traffic area (Elliott & Baughan, 2004) and their children not experiencing or reporting any negative consequences. They may either overtly or inadvertently relay messages to these children of the perceived safety of playing independently on the roads in a higher density urban area. Therefore, while the actual activity brings real risk, the perception of its being risky may not be translated in the types of play being engaged in.

It was interesting that children with higher levels of responsibility beliefs demonstrated lower levels of dangerous play on the road in urban areas than those in rural locations. This may be again a reflection of the higher amount of play on the road in an urban environment out of necessity and proximity. It would appear from this research that children who perceive that they are in control of their behaviour and that their actions may have consequences and do not perceive that it is primarily the responsibility of other people to keep them safe while on the road have adjusted their level of play accordingly in high traffic areas. They may have a higher sense of the actual risk that these activities incur and modify their behaviour to suit the environment.

When examining the final domain, planned protective behaviour, the strongest positive predictors were being a young female pedestrian, having higher levels of exposure to the road environment, being accompanied by an adult and the positive impact of holding higher responsibility beliefs. Negative predictors included an experience of a near miss on the road which was more likely to predict less planned protective behaviour. The relationship between dangerous play and previous near miss experiences could be reinforced by the lack of negative consequences.

Overall, across each of the behaviours assessed living in an urban area has a significant impact in the higher levels of unsafe crossing and dangerous play with lower levels of planned protective behaviour possibly due to the impact of greater frequency of being out around the roads either on their own or with friends. They are in the age group where they have a higher propensity to take more risks than younger children (Dual Systems Theory) and have been afforded greater independence by their parents. They have had previous experience with near miss events in traffic, but this would appear to have strengthened their perception of safety in their behaviour possibly due to lack of what they perceive as negative consequences.

They have become habituated to the presence of traffic and are highly susceptible to both peer influence and distraction putting them at even greater risk. However, there are two very powerful areas which can have a positive impact on their behaviour, the presence of an adult or parent as a role model for good road safety behaviour and having strong responsibility beliefs.

This research on the pedestrian behaviour of children aged 11 to 12 years has contributed significantly to the literature through the identification of previously less considered factors such as personal responsibility beliefs. While this was originally put forward by Elliott and Baughan in 2004, the predictive power of this variable has received very little attention in subsequent research. This large-scale research over two studies has confirmed it as a key area for future research due to the powerful influence it appears to have on the current sample. Further, it has emphasised the importance of peer influence, not just from friends but also through older siblings. While the Theory of Planned Behaviour has been used extensively in road safety for driving and older pedestrian behaviour, very little has focused on the younger adolescent pedestrians used in this sample. This population is at a critical juncture in their lives where they have been afforded more independence but may not have the age-related skills to use the road safely and ability to withstand the negative influence of peers. The question that is very relevant to children of this age range is who is the strongest source of influence, peers, or parents/adults. This study has identified the negative impact of using the road with peers and older siblings and the positive impact when travelling with adults. Based on these findings, the TPB could be utilised more in future research to assess which of the constructs are the strongest influence on young adolescents' behaviour and importantly which norm to use when assessing behavioural intent.

Three constructs influence or determine this behavioural intent: attitude, subjective norm (SN) and perceived behavioural control (PBC). Attitude is either a positive or negative evaluation about performing the target behaviour (Elliott & Thomson, 2010). SN is based on normative beliefs (perceived social norm) about the extent to which important others want them to perform a behaviour and is influenced by the persons own motivation to comply with those beliefs of others. PBC is a person's perception of their ability to perform a given behaviour and is underpinned by perceptions of obstacles, impediments, skills, resources, and opportunities that may inhibit or facilitate performance of the behaviour. In accordance with the model, the more positive a person's attitude and desire to comply to with the perceived SN, and the greater their PBC regarding the target behaviour, the more likely the intent to perform that behaviour. This provides unique challenges to children aged between 11 to 12 years. The literature in Chapter 1 has indicated that children may not have the same skills as adults when crossing a road and as per the results in this study, they may be overestimating their ability to cross the road safely (high self-reporting near miss and unsafe crossing). In support of this, previous research on vulnerable road user's decision to engage in risky pedestrian or cycling behaviours was more significantly predicted by PBC with SN the weakest predictor. However, research has suggested that adolescents, compared to adults, are less driven by rational considerations and more by affective influences such as impulsivity and direct social pressure (Gibbons et al, 2009; Hofmann et al, 2008). In this instance, attitudes may be less important and SN more important predictors in adolescent samples. Previous research on older populations has indicated SNs as the weakest predictor of intentions in applications of the TPB (Armitage & Conner, 2010; Godin & Kok, 1996; Hagger et al., 2002). Therefore, there may be differences in how the SN influences young adolescents compared to adults. The SN is generally thought to comprise of two related components: the descriptive norm (a person's perception of how often others in one's social network will perform the behaviour regardless of whether it is morally correct) and injunctive norm (how much a person thinks that important social referents would want them to perform the behaviour). However, the most frequent norm used in the TPB is injunctive norms e.g., ''What I think others expect me to do" (Armitage & Conner, 2010). It should be noted that literature often does not differentiate between the two types of norms and may refer to either, depending on the study. This needs to be explicitly stated in studies on 11- to 12-year-olds. Three referent groups identified in previous research as potential influence on a young person's decisions include friends, parents, and university peers (Borsari & Carey, 2001; Kuther et al., 2003; McGhie, et al, 2012). Research has indicated that friends (peer influence) can impact significantly upon a young person's decision-making and behaviour if he or she identifies strongly with the friendship group (Jamison & Myers, 2008; Johnston & White, 2003; Wood et al, 2004). For example, young people reported the highest intentions to drink walk in the company of friends who were also drink walking and crossing the road against the pedestrian traffic signal (McGhie et al., 2012). The results of this study demonstrated the negative impact of being around roads with friends and older siblings and the positive impact of being accompanied by adults, therefore, the peer or referent groups that would be important to include would be friends, siblings and parents.

The type of behaviour and potential moderators also must be considered to increase the predictive ability of the TPB. Within this study, a high amount of distracted and risky road crossing while using a mobile phone was reported. This is a growing concern in today's society where children are being given mobile phones at increasingly younger ages. Previous research on older pedestrians suggested mobile phone involvement was an important influence on young people's intentions to use a mobile phone while walking or driving (Lennon et al., 2017; White at al., 2010; Walsh et al., 2011). In these studies, the group norms were included as an additional component based on previous research. Specifically, (Walsh et al., 2008) and (White et al., 2010) found that attitudes and pressure from significant others (injunctive norms) regarding the use of mobile phones, both calling and texting, while driving were significant predictors of a driver's intention to do so. Therefore, in future TPB studies on younger adolescent's pedestrian behaviour, it is important to understand the target behaviour and population, so the most suitable norm or combination of norms are included.

The lack of control over behaviours that are performed frequently and have become habitual may reduce the impact of intention to change, as behaviours are more likely to be triggered and maintained automatically (de Bruijn et al., 2009). A meta-analysis by Ouellette and Wood (1998) reported that when a specific behaviour is practiced repeatedly, and the context of performance is stable, past behaviour becomes a better predictor of future behaviour than intention. Therefore, a key factor to consider in future TPB studies on young pedestrians would be the previous history of near miss incidences. It would appear from the results of this study that children have become habituated to crossing in a riskier manner due to the lack of negative consequences. It is thought that past behaviour may influence variables within the TPB such as attitude or perceived control. It may be that a higher level of past behaviour could lead to less cognitively demanding inputs thereby impacting PBC. Haque et al. (2012) included perceived risk, anticipated regret, and past behaviour in an extended version of the TPB to predict young people's drink walking intentions. The extended TPB explained an additional 6% of the variance compared to the standard model. Therefore, future research should consider the frequency and recency of past behaviour as separate or additional constructs.

The TPB has been used to explain adult and older adolescent road safety behaviour but has not been applied to primary school children's pedestrian behaviour. Typically, the research has suggested the strongest predictors were PBC and the least was SN. However, there have been inconsistencies in the norm used and reported, indicating that the lack of predictive ability may have been hampered by the selection of the SN, specifically if this was not relevant or include all potential referent groups. Children aged between 11 and 12 years are at a crossroads in terms of social influence and offer unique challenges due to their over confidence in their abilities compared to their physical and mental skills, an important component of PBC. An advantage of the TPB is its scope to incorporate additional variables of interest should they potentially enhance the predictive capacity of the model for investigating the target behaviour assuming they are justified theoretically. This study provides evidence to suggest including different referent groups (friends, siblings and parents) and the impact of mobile phone distraction. Therefore, the TPB has a particularly important role in explaining the impact of peer and parental influence on pedestrian behaviour in primary school children. Future research is recommended with a specific focus on the type of behaviour, norm and specifically referent groups to improve the predictive ability of the TPB for young adolescent pedestrian behaviour, as well as its potential for the development of effective interventions within the 11- to 12-year-old cohort.

Section 7.3 Perception of Risk Parent and Child

The impact of adults as positive role models was a theme consistent across the literature in Chapter 1 and is supported by these findings. However, the literature lacked evidence to suggest that parents are aware of their role and understand that through social learning, children are observing and learning from their behaviour on a constant basis. In the second study on the comparison of parent and child rating for their own and observed unsafe crossing, it was obvious there was a disconnect first, between how the parents were reporting their behaviour and what the children observed and second, around the parents' lack of awareness of how their children are actually behaving on the road. From an analysis of both sets of data, there would appear to be an impact of behaviour modelling where there was a higher correlation between what the children were observing their parents doing while crossing the road in their presence and how they behaved when they are on their own. It is important to note there was a pattern of modelling both positive and negative parental behaviours. Interestingly, when parents were asked to rate how they thought the children would behave when crossing the road, they underestimated their level of distraction and unsafe crossing. This may be related to the high rating they have for their children's capability of crossing the road safely in this sample. Parents rated their male children as engaging in more unsafe crossing than their female children, despite having increased perception of risk on the roads for female children. Similarly, when asked about their planned protective behaviour, there was a lot of disparity between what the children reported and how their parents thought they would behave, in particular relating to checking to make sure that traffic has stopped. As children are unlikely to tell their parents how often they have experienced a near miss in traffic, or any dangerous activities they may engage in, there is likely to be a discrepancy between how a parent thinks their child will behave on the road and what that child reports doing. This could be underpinned by cognitive dissonance where parents want to believe their children are behaving safely on the roads when they have allowed them the opportunity for higher levels of independence. It highlights the need to further inform parents of the risks their children may be taking or be exposed to, by crossing in an unsafe manner.

Both parents and children were asked to rate how dangerous they perceived certain behaviours to be, such as playing on a footpath, ranging from 'always dangerous' to 'never dangerous'. It was interesting to note that both the children and parents' ratings for the safety of playing on footpaths in urban areas was quite high and may be indicative of a culture of using the outside footpaths as a play area when living in a cul-de-sac or estate, providing a false sense of safety. Overall, the perceptions of danger are very similar between parent and child and may be indicative of a family culture of road safety. Interestingly, when comparing the results for the responsibility belief scales, parents were asked to rate how they felt their child would respond on this scale. It was interesting to see that the parents generally rated the children higher on responsibility beliefs than the children rated themselves, in particular they felt they would disagree more to 'I do things that are risky when out around the roads'. This would correspond to the impression that their children were either capable or very capable at crossing a road independently. Parents rated their perception of their female children's responsibility beliefs to be higher than that for their male children (a true reflection of the responsibility beliefs in both the larger sample and the smaller sample). However, it was interesting to note that the parents thought their children would rate that drivers should be responsible for their safety, more than they did themselves. This may be a truer reflection of how they as parents perceive the road users around their children.

Overall, when these two studies are compared, there are strong consistencies between both around the importance of responsibility beliefs, the impact of parental and peer modelling, the impact of exposure to traffic, the need for both parents and children to be aware of near miss events and how to avoid them in the future, and finally, closing the gap between how the children are behaving and how their parents perceive them as behaving.

A final component of the second study was to assess what may impact both parents' and children's perceived risk while on the road. Overall, those results were consistent with the literature which finds that female parents demonstrated higher perceived road safety risk. Further, having a higher risk rating for the safety of traffic in the area was also a significant predictor for increased perception of risk. It was interesting to note that that increased parental perception of risk was higher for females than for males. Interestingly, in the current study, while they rated their female children as being at greater perceived risk on the roads, they rated their male children as higher on unsafe crossing than their female children. They also indicated that their female children were more likely to have higher road safety responsibility beliefs than males. This may be linked to higher perceptions of fear of injury in general for females than males. Therefore, while they acknowledge that their female children may have higher responsibility beliefs than their male children and less unsafe crossing, they still perceive their risk as higher. The parents of male children were also more likely to allow their male children to use the roads on their own more frequently than their female children. As noted earlier, unlike in previous research there was no significant impact on the type of dangers (RTC, Abduction, Molestation, Severe injury from falls and disease) that parents perceived as most likely to pose a risk for their children. This may then indicate that parents in this sample are more worried for their female children in general when they are out independently and not just worried about an RTC. This perception of danger could be assessed in more detail through the use of qualitative analysis where parents could be probed further on their decision to allow their female children more autonomy on the road.

Consistent with previous research, parents who had a family history of an RTC rated the risk for their children higher. And interestingly, while having experience of an RTC themselves in the previous 5 years was also a predictor, the impact of family history was higher accounting for the highest amount of variance in the model. Finally, past unsafe road crossing behaviour was the second strongest predictor indicating the power of previous experience. These parents are recognising the risky behaviour they themselves experience and are using it to form a perception of higher risk for their children. The results on unsafe crossing indicated that those who had a higher sense of control in an urban area, also demonstrated higher levels of unsafe crossing. While these questions were designed for children rather than adults with greater skill and expertise in road crossing, it does still suggest that parents/adults are prepared to take more risks as they feel they can control it. Therefore, this suggests a form of cognitive dissonance, as the experience of having a previous RTC has increased their risk perception for their children but are still behaving the same while crossing. Lam (2000) found that parents of families that had experienced an accident had significantly lower risk perceptions than other parents. It was suggested that a strong sense of control is generally expressed in lower risk perception of road safety and on the concept that the person concerned thinks he/she can in fact "control" the risk situation. The sense of control has been confirmed many times as a predicator of risk perceptions, either by influencing behavioural intentions or by increasing the optimism bias (or the risk denial) related to perceptions (DeJoy 1989; Fischoff et al, 2000; Sjoberg, 2000; Vlek & Hendrick, 1989, as cited in Cloutier et al. 2011).

The key predictors for the children's perception of risk were quite similar to that of the parents. For example, being surrounded by heavy traffic while walking to school every day at rush hour decreased the perception of risk. Having older siblings decreased the perception of risk and may be due to less supervision by the parent and the peer influence of older siblings and their friends. The higher the child's reported unsafe crossing the greater the perception of risk, however, the experience of a near miss decreases the perception of risk demonstrating past behaviour is a very strong predictor of risk for both parent and child. Interestingly, they may perceive their unsafe crossing as risky but still continue to behave in the same way due to the perceived lack of negative consequences. Again, these perceptions can be impacted by parental modelling and a family culture of unrealistic optimism that more negative events will not happen despite the family awareness of injury to family friends and themselves.

This study on parent and child pairs has provided a wealth of previously unknown information on the road use behaviour and risk perception in children and parents in Ireland. It has filled a gap in the literature around the relationship between how parents perceive their children's ability and behaviour compared to how their children actually behave on the roads. It has demonstrated the impact of modelling on children's behaviour and importantly, it has highlighted the role of social cognitive theory in the context of road safety education and the ongoing socialisation of children around risk. Despite being rated as riskier road users and holding lower responsibility beliefs, parents were still more likely to allow their male children use the road independently than their female children. According to the Social-Cognitive Theory (SCT; 1986) which started as the Social Learning Theory (SLT) in the 1960s by Albert Bandura, learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behaviour; behavioural capacity (what to do and how to do it), and environmental factors, considering the observational learning ("modelling" behaviours), reinforcements (positive or negative, and internal or external), expectations (anticipated consequences of a person's behaviour) and the concept of self-efficacy, which refers to the own-confidence on the ability to successfully perform a behaviour.

In short, individuals learn behaviours by observing others and behavioural imitation is more likely when there are no negative outcomes or if there are positive outcomes for the behaviour. Therefore, children who do not experience negative consequences or observe peers crossing streets in a risky manner and making it across safely, then they are more likely to imitate that behaviour (Morrongiello & Rennie, 1998; Morrongiello et al., 2013). The number of near misses reported in this study along with the negative impact of peers and siblings would support these findings. Parents may feel greater confidence to let their younger children out around the roads under the supervision of older siblings and peers. However, parents need to be made aware of the impact of older siblings and peers on children's risk decisions. Research has indicated that children are more likely to go along with risk-taking when they highly value the relationship (Morrongiello & Dawber, 2004).

Further, when children in this study observed their parents engaging in riskier road crossing, there was a strong correlation with their own self-reported unsafe crossing. Research (Morroginello et al., 2008) has indicated that children mostly model their own behaviour on parents' behaviour rather than their words. In addition, the older the children get, the more they copy their parents' behaviour, and children notice when parental safety practices are discrepant from what they are being taught. This is another area which has been demonstrated in this research as an important area for education. Parents need to be made explicitly aware of the impact of their own behaviour when using the roads in the presence of their children.

According to social psychological theory, girls are socialised to be wary of risks whereas boys are socialised to be undaunted by potential risks (Harris & Miller, 2000). This may be evidenced by the greater likelihood of parents accompanying female children to school than males reported in the literature. This research has found males were significantly more likely to spend time out around the roads on their own unaccompanied, whereas females were more likely to be out and about the roads in the company of adults. Although often conceptualised as a rational cognitive process, risk perception does not necessarily occur in an emotionally neutral context. Threats of injury or harm often elicit uncomfortable cognitions and emotions including fear, anxiety, and worry. In the field of road safety, this may also be related the social learning principles which suggest children who experience, observe, or learn about others being injured or in danger while crossing the street, might develop fearful emotions surrounding street-crossing, leading the children to avoid or take caution when street-crossing. This is particularly relevant to female children according to the research (Morrongiello & Dawber, 2004) which indicated that girls complied more than boys with maternal requests to avoid approaching a dangerous object, and that children's perception of parental norms about risk-taking were considered much more by girls than boys when they had to choose between three more or less dangerous routes. The over emphasis on being fearful of the roads can have a negative impact on road use behaviour in different ways. Wang et al. (2021) concluded that children's emotional fear may predict risk-taking in traffic. When traffic situations are challenging to cross, fear may appropriately create safer decisions. However, when the traffic situation is less risky, feelings of fear could lead to excessive caution and inefficiency. Shen et al. (2015) found fearful children were more likely to hesitate prior to crossing, entered and crossed within smaller traffic gaps and had increased risk of virtual collisions. Therefore, parents need to be educated on the importance not over focusing on the emotional component of risk around roads which can lead to fearful interactions. This can be moderated with appropriate parental education and modelling of good road use behaviour which may enhance their confidence to use the road safely.

While the previously observed pattern of closer parental supervision on roads for females compared to males in the literature was evidenced in this research, the literature around socialisation is very dated. Therefore, this research has identified a gap in the literature which needs to assess if there has been any difference in how modern parents are educating their children around risk taking. This research would provide an important evidence base to underpin future educational material for parents around the importance of discussing risk in a gender-neutral context and raising awareness on the future impact on behaviour.

Cognitive theory of risk perception also suggest that people have a pervasive tendency to perceive their risk of harm to be below average (Weinstein, 1980, 1984, 1989). Weinstein (1980) referred to this cognitive bias as unrealistic optimism because although some people's risk may be below average, it is unrealistic for everyone's risk to fall below average. It was further noted that children and adolescents are just as likely as adults to exhibit this bias; however, adults may show stronger biases. Self-serving biases about event-related skills, for example, can cause people to believe that they possess the necessary skills to successfully avoid health risk. This is supported by evidence of perceiving lower risks for events involving some element of personal control or error versus for random, unpredictable events (Greening & Chandler, 1997). In this study, parents who felt they could control risks in an urban environment were also more likely to cross in an unsafe or riskier manner. The literature around this area of risk perception is quite dated, therefore, newer research would enhance the understanding of how adults and children today perceive risk, specifically around traffic situations to provide an evidence base for future educational interventions and materials.

Section 7.4 Methodological Strengths and Limitations

Overall, this study was robust in term of methodological rigour applied to the sampling and choice of analysis and sample size. It was evident from the results that the use modelling techniques such as HLM was critical to uncover the relationships between school level and student level variables to highlight important nuances in certain predictor variables. This approach was guided by the literature which indicated that in the educational arena, multilevel modelling techniques such as HLM are used to account for variances in their data while controlling for the effects of clustering (Raudenbush & Byrk, 2002). The large nationally representative sample of 1,100 children from a mix of rural, small urban and large urban primary school provide the ability to generalise the findings to the wider primary school population in Ireland. Further, only six models were produced under the HLM to avoid overfitting which may have impacted generalisability of the results.

However, as with any study, there are areas where it would have benefitted from additional data to aid interpretation of the findings observed at school level. As the first study relied on physical access to primary schools in Ireland, there were some constraints. The necessity to have schools who hosted the 'StreetSmart' programme within the previous two years guided the selection of schools who were invited to participate. Once these schools were identified, the control schools in the same area were also invited to participate. As it can be appreciated, a lot of schools did not want to dedicate their class time to this study as the children in sixth class in Ireland have a very full programme of extra assessments, additional school activities such as confirmation and graduation and a requirement to complete the full curriculum in preparation for secondary school. As a result, there was not a strong enough sample to add the additional variable of social economic status to the analysis. While every effort was made to include an equal weighting of schools in more economically disadvantaged areas (Delivering Equality of Opportunity in Schools; DEIS), it was not possible. Therefore, while the resultant sample does have a representation of these schools in the sample, there were not enough to fairly assess their impact. Sensation seeking was not assessed although it would appear to be relevant in the literature as a mediator for unsafe road behaviour in younger children. It was considered, however, due the age group under assessment, the length of the primary questionnaire and the inclusion in just one other study in combination with the ARBQ, it was decided to exclude it for the sake of brevity of responding due to fatigue in the children.

The size of the individual schools also impacted the ability to break the HLM into three level rather than two level models, as the smaller primary schools had just one class and teacher, while some of the larger schools had two classes (two schools had three classes). However, on attending the larger urban schools which had more than one class, they merged the children into the school hall to minimise the disruption by conducting the survey classroom by classroom. Children were asked by the researcher to identify with a number which class they were in, however very few did making it impossible to decipher their class of origin thus hampering the ability to break the levels down further.

The COVID-19 pandemic also impacted this study as the final round of data collection was scheduled for March 2020 when the school system along with the rest of the world closed its doors. Therefore, there was a time delay which may have impacted the timeliness of the data. The online survey of the matched pairs of parent and child resulted in a predominantly urban location, completed by 90 females and 35 males. The study was redistributed several times via the RSA and social media links, however, the representativeness could not be strengthened. Overall, the research was robust and reflective of both the urban and rural populations across a combination of both study samples.

A final potential limitation to this study was the absence of interviews with parents and children to facilitate a deeper understanding of their perception of risk and around parents' awareness of the impact of their own road use behaviour on their children. While the survey did find some robust evidence to suggest that children are behaving in a manner quite similar to what they have observed in their parents and parents themselves are overestimating their children's safe road crossing, the study would have benefitted from an additional qualitative study to enhance these findings. The only obstacle for this was the time allowed for the study completion.

Section 7.5 Implications of the Research

This research has clearly highlighted the impact of peer influence and modelling on children's behaviour, both positive and negative. As addressed in the literature, the role of parental modelling can greatly enhance the knowledge and skill of children when using the road. The efficacy of education in schools has been demonstrated in the literature to not be as effective alone in a classroom as when it involves parents and peers. While it would not be possible to have roadside instruction for all children in primary schools, the most important source of this education is in their own home. Parents can educate their children and act as role models on a daily basis by simply discussing what makes a road environment risky, discuss how they are crossing the road, engage in decision making discussions with their children when they are about to cross the road. When they are older, this can develop into teaching them how to cross safely in the absence of a controlled crossing and provide both genders equal opportunity to gain independent experience on the road. These are necessary skills for children to learn to enable them to cross traffic safely.

Parents can educate their children on the impact of distraction from mobile phones, a very real threat to children's road safety, both from their own use and that of drivers. They can appreciate that younger children in the family may be more liable to sibling influence and educate their children on the possible impact of this. Importantly, they can foster a climate or culture of road safety within their home as it is evidenced in the literature that it already has a positive impact on young drivers. While it is not possible to control inherent biological risk taking at younger ages, or control all the external risks from the traffic environment and poor driving observed on a daily basis, parents can help their children to foster a strong sense of road safety, foster responsibility beliefs which have been shown to reduce their unsafe behaviour (in females specifically) and empower them to navigate the roads as safely as they can.

Another defining feature of this research is the power of past behaviour and holding strong responsibility beliefs to predict road use behaviour. These are two areas of focus which the RSA can use when designing new interventions or educational messages. Both of these can be integral to simple road safety campaigns that when run in conjunction with parents, can highlight the level of danger associated with past negative behaviour. It will also highlight how their own sense of road safety beliefs can help to effectively reduce the number of unsafe road use behaviours reported in children aged 11 to 12 in Ireland. For example, having higher road responsibility beliefs was identified as a consistently strong moderator for risk, across both study samples, where higher levels reduce the reporting of unsafe crossing and dangerous play but increase the planned protective behaviour.

It is unclear from this study on where these beliefs are coming from. They could be influenced by an individual's personality and developing internal locus of control or influenced by a family climate of road safety where they are constantly observing and internalising good road safety practice. The observed higher responsibility beliefs in the female population may reflect differences in how males and females are socialised towards risk taking and related to their higher compliance with rules as compared with males. It may be a complex interplay of all these underlying factors. However, in the absence of a definite answer in this study, it is suggested as an important avenue for further exploration and to provide families with better road safety messages to impower their children to use the road safely through greater road safety responsibility beliefs.

This study not only adds to the literature around young adolescent's road use behaviour and beliefs, but it highlights the power of using psychological theory including the Theory of Planned Behaviour and Social Cognitive Theory to explain and predict this behaviour.

Section 7.6 Recommendations for Future Research and Practice

Overall, this research has resulted in some unique findings around the behaviours, beliefs and perception of pedestrian risk of children and parents in Ireland. Most strikingly was the power of road safe responsibility beliefs and modelling of behaviour. The holding of higher responsibility beliefs resulted in more planned protective behaviour and less dangerous play and unsafe crossing. This attitudinal variable was significant at both student level and at location, a level two predictor. For unsafe crossing, higher responsibility beliefs resulted in less unsafe crossing for females only. In the dangerous play model, it was observed that higher responsibility beliefs resulted in significantly lower dangerous play on the road in urban locations than in rural location. This has strong implications for the instillation of stronger personal responsibility beliefs in both genders as it has the power to positively impact more safe behaviour as pedestrians on the road. While an attempt was made in this research to locate the source of these beliefs statistically, there is a need to examine these more qualitatively as it was a consistent finding across both large samples of 11- to 12-year-olds. This study also highlighted the risk of distraction due to mobile phone use and a lack of literature relating to mobile phone use and distraction in young adolescents aged 11 to 12 years. Most of the research has focused on older adolescents which will have more mature attentional capacities. This is an important area to provide evidence to underpin age-appropriate educational awareness at school and societal level on the increased danger mobile phone use presents to children who are beginning to use the road independently while at the same time using a mobile phone to maintain contact with family and friends. Males in this study were found to self-report more risky road crossing behaviour than females of the same age when using the roads on their own. However, males were also more likely to report being out around the roads on their own on a much more frequent basis. Therefore, there is a need to control for the level of independent experience with traffic to assess difference in unsafe crossing more accurately between young males and females. It was interesting that while parents rated higher unsafe crossing and lower responsibility beliefs for their male children compared to their female children, they still perceived their female children at higher risk on the roads. Parents were also found to overestimate their children's ability to use the road safely and would appear to allow their male children use the road more frequently on their own compared to their female children. This has implications for socialisation of risk taking and the prevention of independent road use experience in female children. Further, children's road use behaviour in the second study was more similar to what they have observed rather than what the parents were reporting. Therefore, a greater understanding on these findings would facilitate the development of awareness and educational materials for parents around their children's safe independent road use. Therefore, future research would benefit from:

- surveying road safety responsibility beliefs in children and adolescents aged 8 to 18 to assess what age these attitudes begin to emerge and at what stage it may plateau.
- assess differences in road safety responsibility beliefs across the different ages.
- assess additional personality variables such as internal locus of control and sensation seeking and how these relate to responsibility beliefs and behaviour.
- assess cognitive risk perception to determine the impact of unrealistic optimism in traffic environments in children and adults.
- match the gender sample to the reflect an equal amount of time spent on the roads on their own to control for the impact of experience on reported risky road crossing.
- assess the impact of mobile phone distraction in children ages 11 to 12 years to reflect the increased use and address limitations in the literature where distraction has been primarily extrapolated from samples using older adolescents.

- utilise the theory of planned behaviour to assess the impact of peers over the impact of parent and adult role models in children aged between 11 to 12 road use behaviour.
- Qualitatively explore parents reasoning to let their children use the road independently (male and female) and how they form the opinion on their children's capability at crossing the road safely.
- Qualitatively explore parents' knowledge and attitude towards their modelling of road use behaviour.
- Qualitatively assess the family attitudes and culture for road safety that may have a strong impact on the formation of the road safety beliefs.
- Qualitatively assess parent and children's perception of risk around traffic.

From a road safety practice perspective, the following recommendations will be made to the Road Safety Authority:

- Conduct a full review (summative and formative evaluation) of the current education materials and programmes (specifically 'StreetSmart') and method of delivery provided to primary schools in Ireland to assess effectiveness and if based on current evidence and best practice.
- Develop road safety education materials specific to pedestrian and cycling behaviour that will involve parents in the education of their children's safe road use and highlight the importance of modelling good road use behaviour.
- Build in a review of the road safe behaviour of children in sixth class in primary school using the 20 item ARBQ and road safety responsibility belief scale on a periodic basis to chart changes in behaviour over time due to education provided in primary school and wider educational campaigns specific to this age group.
- While it is not mandatory for primary schools to participate in road safety education or initiatives, the RSA should formally consult with the primary schools to identify ways to increase the uptake of the programmes and materials provided.

- Develop educational campaigns to be delivered at national level to highlight the impact of mobile phone distraction and road crossing on children in primary school.
- Commission research focused on responsibility beliefs in young children and adolescents to support the key message from the road safety authority of personal responsibility. This will provide a much-needed evidence base to educate the national population on safe road crossing attitudes and beliefs and reduce unsafe road use behaviour across all modalities of transport.

Section 7.7 Conclusion

Overall, this study has contributed significantly to the wider understanding of road use behaviours in 11- to 12-year-old children in Ireland, their road safety beliefs, risk perception and the corresponding behaviour and risk perception in parents. It has established a tool for the RSA to use to assess changes in primary school children's road use behaviour over time in Ireland and identified two key areas to reinforce namely increasing road safety responsibility beliefs and the impact of parental modelling on children's predicted road use behaviour. It has shone a light onto the importance of refining studies using the TPB to increase the predictive ability in young adolescent pedestrian behaviour and the important consideration of the ongoing impact of Social Cognitive Theory in the socialisation of risk taking and modelling of behaviour in young pedestrians. The creation of a culture of road safety within a family has been shown to increase young people's safer driving. However, it has the power to start earlier when children first start to observe the world around them and become independent road users; to foster safe road use behaviours and attitudes across all modalities which may become habituated through social learning over time. This can have a positive impact on the rates of pedestrian and other traffic related injury and mortality across their lifespan, leading to a safer road environment for us all to enjoy.

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Appendix A: Letters of Information, Consent, Survey Questions

School Information/Consent Form

Evaluation of Irish Primary School Road Safety Education: Programme content, delivery and impact on children's road safety knowledge, attitudes and reported behaviour.

The Road Safety Authority (RSA) is supporting research being conducted by the School of Psychology, Trinity College Dublin, which aims to evaluate the road safety educational interventions being delivered to Irish primary school children by the RSA. The research will be questionnaire-based and will commence in September 2018. The study will examine the impact of RSA education programmes on the road safety-related skills, attitudes and decision-making in sixth class children. This will be compared to the road safety-related, skills, attitudes and decision-making in sixth class children who have not received any of the RSA interventions provided. Your school has been selected as one suitable for inclusion in the research.

This will provide your school with the opportunity to play a part in the accumulation of scientific evidence that will serve to inform best practice in the domain of road safety education in Ireland and internationally. It will also provide us with very important information regarding 11 to 12 year old children's reported road use behaviour and attitudes. Your students will also gain valuable experience of participating in socially relevant research.

Confidentiality is assured for all participating schools and their students. Each school and participant will be assigned a code number and all data files will be named according to this code such that the identity of the participants (if deemed necessary) will not be apparent to observers other than the research team. The school will never be identifiable at any point of the research. If you would consider allowing your school to participate in this research, please complete and return the form attached below at your earliest convenience.

Consent Form: Evaluation of Irish Primary School Road Safety Education: Programme content, delivery and impact on children's road safety knowledge, attitudes and behaviour Schools'

School Contact Details

School Name ______________________

School Address ______________________

School Telephone Number ______________________

Name Sixth Class Teacher ______________________

Telephone Number Person to Contact ______________________

E=mail of Person to Contact ______________________

School Catchment

	Mainly Rural	Mainly Urban
Area (please tick)		

RSA Education Programme(s) Hosted (Please tick)

RSA "National Road Safety Education Service Presentation"	
RSA "Seatbelt Sherriff"	
RSA "Be Safe"	
RSA "StreetSmart"	
RSA "Safe Cross Code "	
RSA "Hi-Glo Silver"	

Sixth Class 2018-2019- Number of Students per Class

Female	Male

Students participating in this research will be asked to complete a questionnaire designed to measure their road safety knowledge, attitude and reported road use behaviour on one occasion only. Sample questionnaires will be available from September 2018 and can be forwarded on request.

Please tick the box to indicate that you agree to facilitate this research by providing a venue for testing and also by recommending participation to your students.

☐

Your Name: ____

On behalf of school: ______________________________________

Principal Researcher	Study Supervised By
Maggie Martin	Dr Michael Gormley
School of Psychology	School of Psychology
Aras an Phiarsaigh	Aras an Phiarsaigh
Trinity College	Trinity College
Dublin 2	Dublin 2
E-mail: mmartin8@tcd.ie	E-mail: Michael.gormley@tcd.ie
Tel: 01-8963083	Tel: 01-8963083

Parent Information/Consent Form

LETTER OF CONSENT (Parents)

Re: Evaluation of Irish Primary School Road Safety Education: Programme content, delivery and impact on children's road safety knowledge, attitudes and behaviour.

Dear parent/guardian,

The school that your son/daughter attends has agreed to participate in this research project that aims to evaluate Irish primary school road safety education. It will evaluate the programme content, delivery and impact on children's road safety knowledge, attitudes and behaviour. This research is being undertaken by Maggie Martin, who is a PhD candidate at the School of Psychology, Trinity College Dublin.

The study will examine the impact of the Road Safety Authority (RSA) education programmes that your son/daughter may have received during their time at primary school on their attitudes and behaviour over time. It will assess the difference in road safety behaviour and attitudes between sixth class children who have experienced at least two of the RSA programmes and those who have never received an RSA education programme.

The research will be conducted using a questionnaire which take approximately 20 minutes to complete on their road use behaviour and attitudes along with questions relating to their age, gender, frequency of being out around the roads and history of previous involvement in an RTC.

Participation in this study is completely voluntary. If you consent to your child taking part, you are free to withdraw them from the study at any stage up to the point when data from all participants have been pooled for analysis (June 30, 2019). If data have already been collected on your child, these data will be destroyed and not included in the final analyses.

Children under the age of 18 years who are under your care should be made aware that their parents/guardians have the right to withdraw them from the research study at any point and they themselves have the right to withdraw from the research study at any point under the same terms as those listed above. Participants will be provided with a copy of the Information/Consent form.

If you agree to allow your son/daughter to participate in this study, all information you and your child supply to us in hard copy (i.e. completed questionnaires and the present form) will be held in confidence and stored in secure facilities in the School of Psychology, Trinity College Dublin. The documents will be destroyed after a period of twelve months. All digital files (i.e. data collected during the study) will be stored in an anonymised format, so your child or school will not be identifiable. Only myself as the lead researcher and my supervisor will have access to these records. All data will only be used for scientific purposes. Your data will not be subject to further processing that is incompatible with the purpose of the present study.

Please note if your child has had personal experience of a road traffic collision themselves or through family or friends you may not want them to participate in this study.

Your child's rights under the Freedom of Information Act 1977 (amended 2003) will be respected at all times. You can have access to any identifiable information we store about your child, if requested.

Further details can be obtained by contacting the principal researcher below:

Principal Researcher	**Study Supervised By**
Maggie Martin	Dr Michael Gormley
School of Psychology	School of Psychology
Aras an Phiarsaigh	Aras an Phiarsaigh
Trinity College	Trinity College
Dublin 2	Dublin 2
E-mail: mmartin8@tcd.ie	E-mail: Michael.gormley@tcd.ie
Tel: 01-8963083	Tel: 01-8963083

Please detach and return this slip to the school. Only children with this form completed on the day can participate.

Please place an X in the box to indicate that you have read and understood all of the above information. ☐

Please indicate that you agree or disagree to your child's participation in this study.

Agree ☐ Disagree ☐

Your Name	

Son/Daughter’s Name	
School Name here	
Date	

Signature:____

Briefing and Instruction

Good morning/afternoon. My name is Maggie Martin and I am here today from the Department of Psychology in Trinity College Dublin. I am working on a study to see how useful road safety education programmes are to you and your behaviour. You have/have not received these programmes and can play a very important role in determining the impact they may or may not have on your road safety knowledge and road user behaviour.

You will be asked to complete a questionnaire and no personal information which will identify you to another person will be asked for. Do not write your name on the questionnaire.

Your school has agreed to participate, and your parents have signed consent forms to allow you to participate. If you feel that you would prefer not to take part in this study, you can tell me now and I will not give you a questionnaire to complete. You can also stop at any stage of the questionnaire, just leave it unfinished and I will remove it from the study.

<u>I will explain the questionnaires to you now:</u>

The questionnaire is called the 'Adolescent Road User Behaviour Questionnaire' and it has a list of 41 questions. You will be asked to rate, on 5-point scales from 'Never' to 'Very Often', the frequency with which you carry out a specific behaviour. The second part of the questionnaire will ask you to give your gender followed by a short set of questions on where you live and your history of any injury or near miss on the road that you have had. It will take about 20 minutes to complete this, but you can take longer if you need to. Answer all of the questions by filling in or placing an x in the boxes provided to show your answer (holding up the questionnaire). I will give you an example on how to complete the questionnaire just before you start.

These questionnaires ask about when you are walking or cycling or being out on your scooter or skateboard. The term walking means going out for a walk, walking to somewhere (to shops or a friend's house), hanging around with friends around roads. When asked about cycling, even if you only cycle one a month or less often than that, please complete the questions on your cycling behaviour. When answering these questions, please think about what you do during school term time and the summer holidays. Please think about all occasions including:

- Before and after school
- On the way to and from school
- At weekends.

When asked about the frequency of behaviour (how often you do something), 'Never' means you have never, not even once, to the best of your memory ever behaved in the manner the question is asking. For example, you never eat grass! 'Hardly Ever' means that you have at **least once** behaved in the manner the question is asking but very rarely. 'Sometimes' will be similar to any situation where you may sometimes meet friends after school, sometimes go to the park with friends. You do it on occasion but not very frequently. Therefore, you may sometimes cross the road on in a certain manner but not very often. If you think that you do behave in a manner more frequently or often, please chose either 'Fairly Often' or 'Very Often'. Keep in mind that 'Very Often' would be most of the times you cross the road or are out and about on the roads, you almost always do it. Does everyone understand the difference in the terms we have chatted about (Hardly Ever, Sometimes etc). If no, please let me know and we will run through the instructions again.

You are asked to let us know if you have ever had a 'Near Miss' on the road. Does anyone know what that means? Once they have replied I clarify for them that a 'Near Miss' is when you have started to cross the road or are almost across the road but the car or oncoming vehicle (bus, van, tractor, Lorry, HGV) is coming very very close to you and you have to make a very quick move to avoid being hit. You have **just missed** being hit by the vehicle. If the children are unclear, I will repeat the description and answer examples that children may give.

Please do not talk to other people about your answers. The answers you give should be your own, based on what you actually think and what you actually do. I would ask that you answer all questions honestly and as clearly as you can. There is no right or wrong answer and no way of identifying or knowing you as the person who completed the questionnaire. The information you give us is extremely important and will help to improve road safety education programmes in Ireland and across the rest of the world for children.

I would like to thank you for taking part in this study as it is really very helpful to us. If you have any questions, please raise your hand and I will answer them now before we start.

<u>Instructions specific to the ARBQ</u>.

To help you complete the questionnaire here is an example of a question and how to answer it. One question might be:

When crossing a road, how often do you use a lollipop man/lady when there is one available?

You will be given 5 possible options to choose from. These are:

- Never

- Hardly ever
- Sometimes
- Fairly often
- Very often.

If you never use a lollipop man/lady to cross the road when there is one available, you would tick the never box. If you only rarely use a lollipop man/lady when one is available, you would tick the hardly ever box and so on.

All questions in this questionnaire are like this. The questions change but they should be answered in similar way to this one.

Ref:__________________

Adolescent Road User Behaviour Questionnaire

This questionnaire asks you about what you do when you go out around roads on foot or on a bicycle. When answering the questions, think about what you do during the summer. Think about all occasions including before and after school, on the way to and from school and at weekends.

PLEASE ANSWER **ALL** OF THE QUESTIONS.

SECTION 1: WHAT DO YOU DO WHEN YOU GO OUT?

*For each of the following questions, please tick **ONE** box on **EACH** line.*

Never	Less than once a week	1-3 days a week	4-6 days a week	Every day

Q.1	If you use a bike, how often do you go out and ride it?	❑	❑	❑	❑	❑
Q.2	How often do you go out and ride a scooter, skateboard or roller skates?	❑	❑	❑	❑	❑
Q.3	How often do you go out walking ?	❑	❑	❑	❑	❑

		Never	Less than once a week	1-3 days a week	4-6 days a week	Every day
Q.4	**When you go out around roads, how often do you do this:**					
(a)	With Adults?	❑	❑	❑	❑	❑
(b)	With Friends?	❑	❑	❑	❑	❑
(c)	On my own?	❑	❑	❑	❑	❑

SECTION 2: HOW DO YOU ACT WHEN YOU ARE OUT?

*For each of the following questions, please tick **ONE** box on **EACH** line.*

Q.5 **<u>When crossing a road</u>, how often do you:**

		Never	Hardly Ever	Some-times	Fairly Often	Very Often
(a)	Use a lollipop man/lady when there is one available?	❑	❑	❑	❑	❑
(b)	Forget to look properly because you are thinking about something else?	❑	❑	❑	❑	❑
(c)	Use a mobile phone and forget to look properly?	❑	❑	❑	❑	❑
(d)	Forget to look properly because you are talking to friends who are with you?	❑	❑	❑	❑	❑
(e)	Cross whether traffic is coming or not, thinking that the traffic should stop for you?	❑	❑	❑	❑	❑
(f)	Not look because you can't hear any traffic around?	❑	❑	❑	❑	❑
(g)	Think you have enough time to cross safely, but a car is coming faster than you thought?	❑	❑	❑	❑	❑
(h)	Check to make sure the traffic has completely stopped before you cross at a pedestrian crossing?	❑	❑	❑	❑	❑
(i)	Climb over barriers or railings /fence that separate the road from the footpath?	❑	❑	❑	❑	❑
(j)	Wear reflective clothing?	❑	❑	❑	❑	❑
(k)	Not bother walking to a nearby crossing to cross the road?	❑	❑	❑	❑	❑

*For each of the following questions, please tick **ONE** box on **EACH** line.*

Q.6 <u>When crossing a road</u>, how often do you:

		Never	Hardly Ever	Some-times	Fairly Often	Very Often
(a)	Look both ways before crossing?	❑	❑	❑	❑	❑
(b)	Keep looking and listening for traffic until you get all the way across the road?	❑	❑	❑	❑	❑
(c)	Have to stop quickly or turn back to avoid traffic?	❑	❑	❑	❑	❑
(d)	Get half way across a road and then have to run the rest of the way to avoid traffic?	❑	❑	❑	❑	❑
(e)	Cross from between parked cars when there is a safer place to cross nearby?	❑	❑	❑	❑	❑
(f)	Cross from behind a stationary vehicle (for instance a bus that has stopped?	❑	❑	❑	❑	❑
(g)	Cross without waiting for the "green man" at a pedestrian crossing?	❑	❑	❑	❑	❑
(h)	Cross when you can't see both ways very well (like on a bend/top of a hill)?	❑	❑	❑	❑	❑

		Never	Hardly Ever	Some-times	Fairly Often	Very Often
(i)	Cross at a place that is well light when it is dark so that drivers can see you more easily?	❑	❑	❑	❑	❑
(j)	Make traffic slow down or stop to let you cross?	❑	❑	❑	❑	❑
(k)	See a small gap in the traffic and "go for it"?	❑	❑	❑	❑	❑
(l)	Run across a road without looking because you are in a hurry?	❑	❑	❑	❑	❑

*For each of the following questions, please tick **ONE** box on **EACH** line.*

Q.7 How often do you do these things when you are out?

		Never	**Hardly Ever**	**Some-times**	**Fairly Often**	**Very Often**
(a)	Run around in the road (when playing football or other games)?	❑	❑	❑	❑	❑
(b)	Not notice an approaching car when playing games in the road?	❑	❑	❑	❑	❑
(c)	Play "chicken" by deliberately running out in front of traffic?	❑	❑	❑	❑	❑
(d)	Hold onto a moving vehicle when riding a bike?	❑	❑	❑	❑	❑
(e)	Hold on to a moving vehicle when on a skateboard, scooter or roller-skates /blades?	❑	❑	❑	❑	❑

(f)	Hang around on the road talking to friends?	❑	❑	❑	❑	❑
(g)	Ride a scooter, skateboard or roller-skates/blades on the road?	❑	❑	❑	❑	❑
(h)	Ride out onto the road on a scooter, skateboard or roller-skates / blades without thinking to check for traffic?	❑	❑	❑	❑	❑
(i)	Run into the road to get a ball, without checking for traffic?	❑	❑	❑	❑	❑

*For each of the following questions, please tick **ONE** box on **EACH** line.*

Q.8 How often do you do these things when you are out?

		Never	**Hardly Ever**	**Some-times**	**Fairly Often**	**Very Often**
(a)	Not notice a car pulling out (say from a driveway or entrance) and walk in front of it?	❑	❑	❑	❑	❑
(b)	Walk in the road rather than on the footpath?	❑	❑	❑	❑	❑
(c)	Walk in the road facing the traffic when on roads with no footpaths?	❑	❑	❑	❑	❑
(d)	Deliberately run across the road without looking for a dare?	❑	❑	❑	❑	❑

(e)	Wear reflective clothing when out on foot in the dark?	❑	❑	❑	❑	❑
(f)	Walk in single file on roads without a footpath?	❑	❑	❑	❑	❑
(g)	Wear a cycle helmet when riding a bike?	❑	❑	❑	❑	❑
(h)	Wear reflective clothing when riding a bike in the dark?	❑	❑	❑	❑	❑
(i)	Use lights on your bike when it's dark?	❑	❑	❑	❑	❑

SECTION 3: YOUR BELIEFS AND OPINIONS

F*or each of Indicate how you feel about these statements by ticking* ***ONE*** *box on* ***EACH*** *line.*

		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Q.9	I do things that are risky when I am out around roads.	❑	❑	❑	❑	❑
Q.10	I generally pay a lot of attention to the traffic when I am out around roads.	❑	❑	❑	❑	❑

Q.11	In general, I act responsibly when I am out around roads.	❑	❑	❑	❑	❑
Q.12	I am aware of the dangers around the roads.	❑	❑	❑	❑	❑
Q.13	I should be responsible for my own safety when I am out around roads.	❑	❑	❑	❑	❑
Q.14	Drivers should be responsible for my safety when I am out around roads.	❑	❑	❑	❑	❑
Q.15	Other people should be responsible for my safety when I am out around roads.	❑	❑	❑	❑	❑

SECTION 4: INFORMATION ABOUT YOU

Q.16 How old are you? _______________

Q.17 Are you:

Male ❑ Female ❑ Other ❑

Q.18 Do you live:

In a town or village ❑ In the country

Q.19 **How often have you had a narrow miss (just missed being hit) with a vehicle when using the road?**

Never ❑

Hardly Ever ❑

Some-times ❑

Fairly Often ❑

Very Often ❑

Q. 20 Have you had a previous history of a road traffic collision in the last 5 years?

Yes ❑ No ❑

Q. 21 If yes, would you describe it as:

A minor injury no overnight hospital stay. ❑

A serious injury at least one overnight hospital stay. ❑

Q. 22 Please indicate at the time of the collision were you a:

Pedestrian ❑

Cyclist ❑

Driver ❑

Passenger ❑

Q. 23 Has a family member or close friend had a previous history of road traffic injury

Yes ❑ No ❑

Q. 24 If yes, would you describe it as:

A minor injury no overnight hospital stay ❑

A serious injury at least one overnight hospital stay ❑

Fatal ❑

Q. 25 Please indicate at the time of the collision were they a:

Pedestrian ❑

Cyclist ❑

Driver ❑

Passenger ❑

F.A.O. Maggie Martin
Approval ID: SPREC102019-25

School of Psychology Research Ethics Committee

27th January 2020

Dear Maggie,

The School of Psychology Research Ethics Committee has reviewed your application entitled "Evaluation of Irish Primary School Road Safety Education: Programme content, delivery and impact on children's road safety knowledge,attitudes and behaviour" and I am pleased to inform you that it was approved.

Please note that you will be required to submit a completed Project Annual Report Form on each anniversary of this approval, until such time as the research is complete and the thesis is submitted. The form is available for download from the Ethics section of the School website.
Please note that you must be familiar with and adhere to the attached 'Safety Protocol for Adults'.
Adverse events associated with the conduct of this research must be reported immediately to the Chair of the Ethics Committee.

Yours sincerely,

Richard Carson
Chair,
School of Psychology Research Ethics Committee

SCHOOL OF PSYCHOLOGY
Arás an Phiarsaigh
Trinity College
Dublin 2

TCD Security: 01 896 1317

Any incidents such as those described below **must** be reported to the Head of School and to the Ethics Committee

<u>SCENARIO 1:</u> Participant becomes distressed without apparent cause. No risk of harm is evident to researcher.

The lab environment may be intimating. During testing, a participant becomes notably distressed or uncomfortable.

Response:

- End data collection.
- Ask how the participant is feeling to identify problem: e.g., *are you feeling overwhelmed/claustrophobic/uncomfortable etc?*
- Remind the participant of their right to end data collection and/or withdraw from the study at any time.
- Offer a break. Offer water. Ask if they'd like to step outside. Ask if they have any strategies (e.g., mindfulness) that help when they are feeling distressed.
- After the session has ended, inform study PI. Review study procedures to understand the source of the distress and to identify if recurrence can be prevented.

<u>SCENARIO 2:</u> Participant discloses a history of self-harm or current plans to self-harm

It is possible a participant will disclose information that suggests that they are at risk through their own behaviour. Here, assess the risk level and decide an appropriate response.

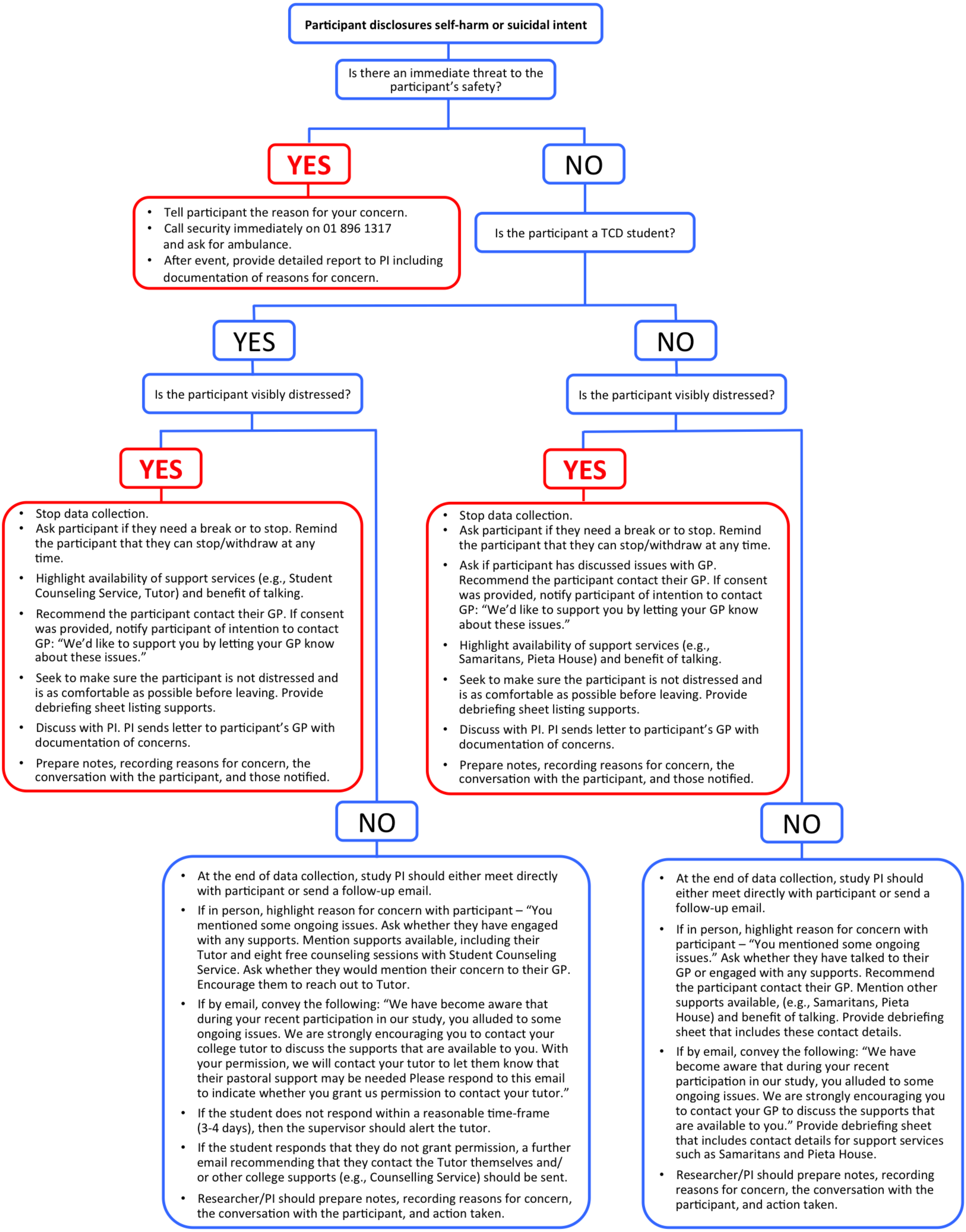
Risk assessment is informed by three pieces of evidence. Any one of these alone may be sufficient to prompt a response.

1. Excessive concern of experimenter.
   - *Does the participant's behaviour, words, or actions worry you?*
   - *Have they indicated (e.g., on a clinical assessment) that they are experiencing high levels of distress and/or have a suicide plan?*

2. Immediacy of risk.
   - Do the participant's words or actions suggest that they are at immediate risk – e.g., suicide plan is ready.

3. Availability of support services – what is the answer to the following questions?
   - *"Are you in counselling?"*
   - *"Are you in contact with a mental health service?"*
   - *"Does anyone else know about these feelings?"*

4. Is the participant a TCD student or someone from outside the College?


Participant disclosures self-harm or suicidal intent
Is there an immediate threat to the participant's safety?
YES
NO
• Tell participant the reason for your concern.
• Call security immediately on 01 896 1317 and ask for ambulance.
• After event, provide detailed report to PI including documentation of reasons for concern.
Is the participant a TCD student?
YES
NO
Is the participant visibly distressed?
Is the participant visibly distressed?
YES
• Stop data collection.
• Ask participant if they need a break or to stop. Remind the participant that they can stop/withdraw at any time.
• Highlight availability of support services (e.g., Student Counseling Service, Tutor) and benefit of talking.
• Recommend the participant contact their GP. If consent was provided, notify participant of intention to contact GP: "We'd like to support you by letting your GP know about these issues."
• Seek to make sure the participant is not distressed and is as comfortable as possible before leaving. Provide debriefing sheet listing supports.
• Discuss with PI. PI sends letter to participant's GP with documentation of concerns.
• Prepare notes, recording reasons for concern, the conversation with the participant, and those notified.
YES
• Stop data collection.
• Ask participant if they need a break or to stop. Remind the participant that they can stop/withdraw at any time.
• Ask if participant has discussed issues with GP. Recommend the participant contact their GP. If consent was provided, notify participant of intention to contact GP: "We'd like to support you by letting your GP know about these issues."
• Highlight availability of support services (e.g., Samaritans, Pieta House) and benefit of talking.
• Seek to make sure the participant is not distressed and is as comfortable as possible before leaving. Provide debriefing sheet listing supports.
• Discuss with PI. PI sends letter to participant's GP with documentation of concerns.
• Prepare notes, recording reasons for concern, the conversation with the participant, and those notified.
NO
• At the end of data collection, study PI should either meet directly with participant or send a follow-up email.
• If in person, highlight reason for concern with participant – "You mentioned some ongoing issues. Ask whether they have engaged with any supports. Mention supports available, including their Tutor and eight free counseling sessions with Student Counseling Service. Ask whether they would mention their concern to their GP. Encourage them to reach out to Tutor.
• If by email, convey the following: "We have become aware that during your recent participation in our study, you alluded to some ongoing issues. We are strongly encouraging you to contact your college tutor to discuss the supports that are available to you. With your permission, we will contact your tutor to let them know that their pastoral support may be needed Please respond to this email to indicate whether you grant us permission to contact your tutor."
• If the student does not respond within a reasonable time-frame (3-4 days), then the supervisor should alert the tutor.
• If the student responds that they do not grant permission, a further email recommending that they contact the Tutor themselves and/ or other college supports (e.g., Counselling Service) should be sent.
• Researcher/PI should prepare notes, recording reasons for concern, the conversation with the participant, and action taken.
NO
• At the end of data collection, study PI should either meet directly with participant or send a follow-up email.
• If in person, highlight reason for concern with participant – "You mentioned some ongoing issues." Ask whether they have talked to their GP or engaged with any supports. Recommend the participant contact their GP. Mention other supports available, (e.g., Samaritans, Pieta House) and benefit of talking. Provide debriefing sheet that includes these contact details.
• If by email, convey the following: "We have become aware that during your recent participation in our study, you alluded to some ongoing issues. We are strongly encouraging you to contact your GP to discuss the supports that are available to you." Provide debriefing sheet that includes contact details for support services such as Samaritans and Pieta House.
• Researcher/PI should prepare notes, recording reasons for concern, the conversation with the participant, and action taken.

Parent and Child Study

Qualtrics

The following information was provided at the start of the survey to inform participants once they clicked on the link provided on the email.

This study aims to investigate primary school children aged 11 to 12 years and their parents' road safety attitudes and behaviour. This research is being undertaken by Trinity College Dublin and funded by the Road Safety Authority. The study will examine 6th class children reported risky road use behaviours, attitude to their own pedestrian behaviour and their perception of risk on the roads. To assist in this, as parents/guardians you will also be asked to provide an assessment of your child's actual behaviour, their risk perception and a self-report of your own pedestrian behaviour. The anticipated outcome is a deeper understanding of child pedestrian behaviour, the actual reported behaviour of children/parents and predictors of risk perception for both the parent and child. The RSA is constantly looking for ways to reduce the number of injuries and fatalities due to road traffic collisions. Your participation in this research will provide valuable information necessary to develop improved road safety messages and education for parents and children in Ireland. If you want to take part in the online survey you will next be presented with a section to indicate that you and your child have given consent to take part in the study. It will not be possible to continue with the survey unless consent is provided. Please note if you or your child has had personal experience of a road traffic collision themselves or through family or friends you may not want to participate in this study. Thank you for taking the time to participate. If you want any more detail on the study, you can contact the researcher Maggie Martin on Mmartin8@tcd.ie.

Section 1: Parent Survey Questions hosted on Qualtrics

1.	**Gender**	
2.	**Age**	
3	**Education** Please tick all that apply	Primary Secondary

		Third Level Post Graduate level
4.	**How many children in your home?**	
5.	**Describe where you live.** Please tick one that most applies.	Rural countryside Village Small country town Large country town City
6.	**If you live in the countryside where best describes your home?**	On a lane On a small country road On a larger country road (links two urban areas) On a national road (main roads between urban areas)
7.	**If you live in a village, town or city, where best describes your home?**	On a regional road (country road) On a national road (main road connecting urban centres) In an estate (cul-de-sac) In an estate (with through traffic) On a street
9.	**How would you describe the traffic environment around your home?**	Very light traffic Light traffic Heavy traffic Very heavy traffic
10.	**How would you rate the traffic environment around your home?**	Pretty safe Very safe Neither safe or unsafe A little unsafe Very unsafe
11. (a)	**Have you had a previous history of a road traffic collision in the last 5 years?**	Yes No

(b)	**If yes, would you describe it as:**	A minor injury no overnight hospital stay. A serious injury at least one overnight hospital stay.
(c)	**Please indicate at the time of the collision were you a:**	Pedestrian Cyclist Driver Passenger
12. (a)	**Has a family member or close friend had a previous history of road traffic injury**	Yes No
(b)	**If yes, would you describe it as:**	A minor injury no overnight hospital stay. A serious injury at least one overnight hospital stay. Fatal
(c)	**Please indicate at the time of the collision were they a:**	Pedestrian Cyclist Driver Passenger
13.	**How often did you walk yourself for pleasure/fitness/to work?**	Never ❑ Less than once a week ❑ 1 to 3 days a week ❑ 4 to 6 days a week ❑ Everyday ❑
14.	**How do you think children learn to cross a road independently?** **(**Main method, please pick one)	They have to be taught by parent. They have to be taught in school. They will naturally acquire the skill with experience. They develop the skill with age.
15.	**What age you think a child should be able to cross the road independently**	
16.	**How often do you do the following when walking or crossing with your child?** **Never** **Hardly Ever** **Some-times** **Fairly Often** **Very Often**	

	Forget to look properly because you are talking to people/child who are with you? Check to make sure the traffic has completely stopped before you cross at a pedestrian crossing? Use a mobile phone and forget to look properly? Not bother walking to a nearby crossing to cross the road? Have to stop quickly or turn back to avoid traffic? Look both ways before crossing? Cross from behind a stationary vehicle (for instance a bus that has stopped? See a small gap in the traffic and "go for it"? Wear reflective clothing when walking on roads? Walk in the road facing the traffic when on roads with no footpaths? Walk in single file on roads without a footpath? Cross from between parked cars when there is a safer place to cross nearby? Think it is OK to cross safely, but a car is coming faster than you thought? Run across a road without looking because you are in a hurry? Cross whether traffic is coming or not, think the traffic should stop for you? Get part way across the road and then have to run the rest of the way to avoid traffic?
17.	**Please rate your level of agreement with the following statements:** Circle one only I can control road risks when walking along a country road close to my home. **Strongly Agree** **Agree** **Not Sure** **Disagree** **Strongly Disagree** I can control road risks when walking in an urban area. **Strongly Agree** **Agree** **Not Sure** **Disagree** **Strongly Disagree**
18.	**How dangerous do you rate these behaviours a child might engage in (Likert scales 1 - 5)** 1. Playing on a footpath 2. Playing on a country road 3. Crossing at a pedestrian crossing without traffic lights 4. Crossing when the pedestrian light is red and there are no cars coming 5. Crossing when the pedestrian light is green

	6. Crossing the street other than at a pedestrian crossing (with and without signal) 7. Crossing the street without looking 8. Crossing the street from between parked cars					
Please answer the following questions relating to your child/children aged 11-12 years						
19.	What position is the child in the family	First born Second born Third born Fourth born Fifth born Sixth born				
20.	**How often do you let your child go out on a country/rural road:**	**Never**	**Less than once a week**	**1-3 days a week**	**4-6 days a week**	**Every day**
	(a) With Adults?	❑	❑	❑	❑	❑
	(b) With Friends?	❑	❑	❑	❑	❑
	(c) On their own?	❑	❑	❑	❑	❑
21.	**How often do you let your child go out in a town/village/city**	**Never**	**Less than once a week**	**1-3 days a week**	**4-6 days a week**	**Every day**
	(a) With Adults?	❑	❑	❑	❑	❑
		❑	❑	❑	❑	❑

	(b) With Friends? **(c)** On their own?	❑ ❑ ❑ ❑ ❑
22	**How does your child <u>mostly</u> travel to school**	Car Bus Walk Cycle Other
23. (a)	**How capable is your child at crossing the street alone?**	Very capable Capable Somewhat capable Not capable
(b)	**If you indicated your child was not capable, please tick all that apply:**	Lack of experience Inattentive or distracted child Traffic too heavy Traffic very fast Nervous child Other____ ____
24	**Please rank in order of danger the risk that they pose to your children from 1 = very high risk to 5 = not high risk at all**	Falls/injuries not related to road traffic collision ________ Molestation______ Kidnapping_______ Road traffic collisions______ Severe diseases__________
25	**Please indicate how <u>you think</u> your child would rate the following questions.** **Strongly Agree** **Agree** **Not Sure** **Disagree** **Strongly Disagree**	
	I do things that are risky when I am out around roads. I generally pay a lot of attention to the traffic when I am out around roads. In general, I act responsibly when I am out around roads.	

	I am aware of the dangers around the roads. I should be responsible for my own safety when I am out around roads. Drivers should be responsible for my safety when I am out around roads. Other people should be responsible for my safety when I am out around roads.
26.	**Please indicate how <u>you think</u> your child would behave under the following questions (i.e. what they actually do when they are on the roads on their own)**

	<u>When crossing a road</u>, how often do you:	**Never**	**Hardly Ever**	**Some-times**	**Fairly Often**	**Very Often**
	Forget to look properly because you are talking to people/child who are with you? Check to make sure the traffic has completely stopped before you cross at a pedestrian crossing? Use a mobile phone and forget to look properly? Not bother walking to a nearby crossing to cross the road? Have to stop quickly or turn back to avoid traffic? Look both ways before crossing? Cross from behind a stationary vehicle (for instance a bus that has stopped? See a small gap in the traffic and "go for it"? Wear reflective clothing when walking on roads? Walk in the road facing the traffic when on roads with no footpaths? Walk in single file on roads without a footpath? Cross from between parked cars when there is a safer place to cross nearby? Think it is OK to cross safely, but a car is coming faster than you thought? Run across a road without looking because you are in a hurry? Cross whether traffic is coming or not, think the traffic should stop for you? Get part way across the road and then have to run the rest of the way to avoid traffic?					

Section 2: Child Survey

	Gender	Male/Female/Prefer not to say
1.	**Age**	
2.	**How would you describe the amount of traffic around your home?**	Very light traffic Light traffic Heavy traffic Very heavy traffic
3.	**How would you rate the road safety around your school?**	Very safe Pretty Safe Neither safe or unsafe A little unsafe Very unsafe
4. (a)	**Have you had a previous history of a road traffic collision in the last 5 years?**	Yes No
(b)	**If yes, would you describe it as:**	A minor injury no overnight hospital stay. A serious injury at least one overnight hospital stay.
(c)	**Please indicate at the time of the collision were you a:**	Pedestrian Cyclist Passenger
5. (a)	**Has a family member or close friend had a previous history of road traffic injury**	Yes No
(b)	**If yes, would you describe it as:**	A minor injury no hospital stay overnight. A serious injury stayed in hospital for one or more nights. They died.
(c)	**Please indicate at the time of the collision were they a**	Pedestrian Cyclist Driver Passenger

7.	**How often do you do see your parent do the following when walking or crossing the road? Pick one for each question.** **Never Hardly Ever Some-times Fairly Often Very Often**
	Forget to look properly because you are talking to people/child who are with you? Check to make sure the traffic has completely stopped before you cross at a pedestrian crossing? Use a mobile phone and forget to look properly? Not bother walking to a nearby crossing to cross the road? Have to stop quickly or turn back to avoid traffic? Look both ways before crossing? Cross from behind a stationary vehicle (for instance a bus that has stopped? See a small gap in the traffic and "go for it" Wear reflective clothing when walking on roads? Walk in the road facing the traffic when on roads with no footpaths? Walk in single file on roads without a footpath? Cross from between parked cars when there is a safer place to cross nearby? Think it is OK to cross safely, but a car is coming faster than you thought? Run across a road without looking because you are in a hurry? Cross whether traffic is coming or not, think the traffic should stop for you? Get part way across the road and then have to run the rest of the way to avoid traffic?
8.	**How dangerous do you rate these behaviours you might engage in? Likert scale 1 to 5** 1. Playing on a footpath 2. Playing on a country road 3. Crossing at a pedestrian crossing without traffic lights 4. Crossing when the pedestrian light is red and there are no cars coming 5. Crossing when the pedestrian light is green 6. Crossing the street other than at a pedestrian crossing (with and without signal) 7. Crossing the street without looking 8. Crossing the street from between parked cars
9	**How often have you had a narrow miss (<u>just missed being hit</u>) with a vehicle when using the road**? Never ❑

	Hardly Ever ❑ Some-times ❑ Fairly Often ❑ Very Often ❑
10	**Indicate how you feel about these statements by ticking ONE box on EACH line.** **Strongly Agree** **Agree** **Not Sure** **Disagree** **Strongly Disagree**
	I do things that are risky when I am out around roads. I generally pay a lot of attention to the traffic when I am out around roads. In general, I act responsibly when I am out around roads. I am aware of the dangers around the roads. I should be responsible for my own safety when I am out around roads. Drivers should be responsible for my safety when I am out around roads. Other people should be responsible for my safety when I am out around roads.
11.	**When crossing a road, how often do you:** — **Never** **Hardly Ever** **Some-times** **Fairly Often** **Very Often**
	Forget to look properly because you are talking to people/child who are with you? Check to make sure the traffic has completely stopped before you cross at a pedestrian crossing? Use a mobile phone and forget to look properly? Not bother walking to a nearby crossing to cross the road? Have to stop quickly or turn back to avoid traffic? Look both ways before crossing? Cross from behind a stationary vehicle (for instance a bus that has stopped? See a small gap in the traffic and "go for it"? Wear reflective clothing when walking on roads? Walk in the road facing the traffic when on roads with no footpaths? Walk in single file on roads without a footpath?

	Cross from between parked cars when there is a safer place to cross nearby? Think it is OK to cross safely, but a car is coming faster than you thought? Run across a road without looking because you are in a hurry? Cross whether traffic is coming or not, think the traffic should stop for you? Get part way across the road and then have to run the rest of the way to avoid traffic?

I would like to thank both you and your child sincerely for taking part in this study. The study will examine the impact of observed pedestrian behaviour, the perception of pedestrian risk and the attitude towards road safety in the family unit. The aim is to increase our knowledge of the actual behaviour of pedestrians so that we can create a stronger culture of road safety attitudes and increase road safe behaviour. The focus of the Road Safety Authority is to save lives and this research will contribute strongly to education messages for the Irish population. Many children are seriously injured or killed every year while using our roads. If we all try to behave more safely, the numbers of such injuries and deaths can be reduced. Each time we go on the roads either as a driver, passenger, pedestrian or cyclist we need to behave in a safe way. Please pay attention when using the road or travelling in a car and behave in a way that will not put you or others in danger. Your participation today will help us to further understand how education can improve road use behaviour and hopefully, lower the number of people being killed unnecessarily on our roads.

If you start to feel upset or anxious about any of the questions that you answered today, please let us know, or talk to a trusted adult or health professional as soon as possible. I have included a number on this sheet of the relevant services who can be contacted to help talk about these feelings.

Support Services Contact Details: The Child and Family Agency (Tusla): 01 7718500 This is a national service so if you call the number above you will be directed to the appropriate service for your region. https://www.tusla.ie/services/family-community-support/counselling/

The HSE - child psychology and general mental health services. If you access this link you will be able to select the service for your region with the appropriate telephone number. https://www.hse.ie/eng/services/list

If you want any more information on this study, you can contact me at mmartin8@tcd.ie. Many thanks again and remember, stay safe on the roads. Kind Regards, Maggie

F.A.O. Maggie Martin

Approval ID: SPREC SPREC102021-34

School of Psychology Research Ethics Committee

16th March, 2022

Dear Maggie,

The School of Psychology Research Ethics Committee has reviewed your application entitled "Parents' perception of child pedestrian risk", and I am pleased to inform you that it was approved.

Please note that you will be required to submit a completed Project Annual Report Form on each anniversary of this approval, until such time as the research is complete and the thesis is submitted. The form is available for download from the Ethics section of the School website.

Adverse events associated with the conduct of this research must be reported immediately to the Chair of the Ethics Committee.

Yours sincerely,

Prof. Robert Whelan
Chair
School of Psychology Research Ethics Committee

TCD Security: 01 896 1317

Any incidents such as those described below **must** be reported to the

Head of School and to the Ethics Committee

<u>SCENARIO 1:</u> Participant becomes distressed without apparent cause. No risk of harm is evident to researcher.

The lab environment may be intimating. During testing, a participant becomes notably distressed or uncomfortable.

Response:

- End data collection.
- Ask how the participant is feeling to identify problem: e.g., *are you feeling overwhelmed/claustrophobic/uncomfortable etc?*
- Remind the participant of their right to end data collection and/or withdraw from the study at any time.
- Offer a break. Offer water. Ask if they'd like to step outside. Ask if they have any strategies (e.g., mindfulness) that help when they are feeling distressed.
- After the session has ended, inform study PI. Review study procedures to understand the source of the distress and to identify if recurrence can be prevented.

<u>SCENARIO 2:</u> <u>Participant discloses a history of self-harm or current plans to self-harm</u>

It is possible a participant will disclose information that suggests that they are at risk through their own behaviour. Here, assess the risk level and decide an appropriate response.

Risk assessment is informed by three pieces of evidence. Any one of these alone may be sufficient to prompt a response.

1. Excessive concern of experimenter.

- *Does the participant's behaviour, words, or actions worry you?*
- *Have they indicated (e.g., on a clinical assessment) that they are experiencing high levels of distress and/or have a suicide plan?*

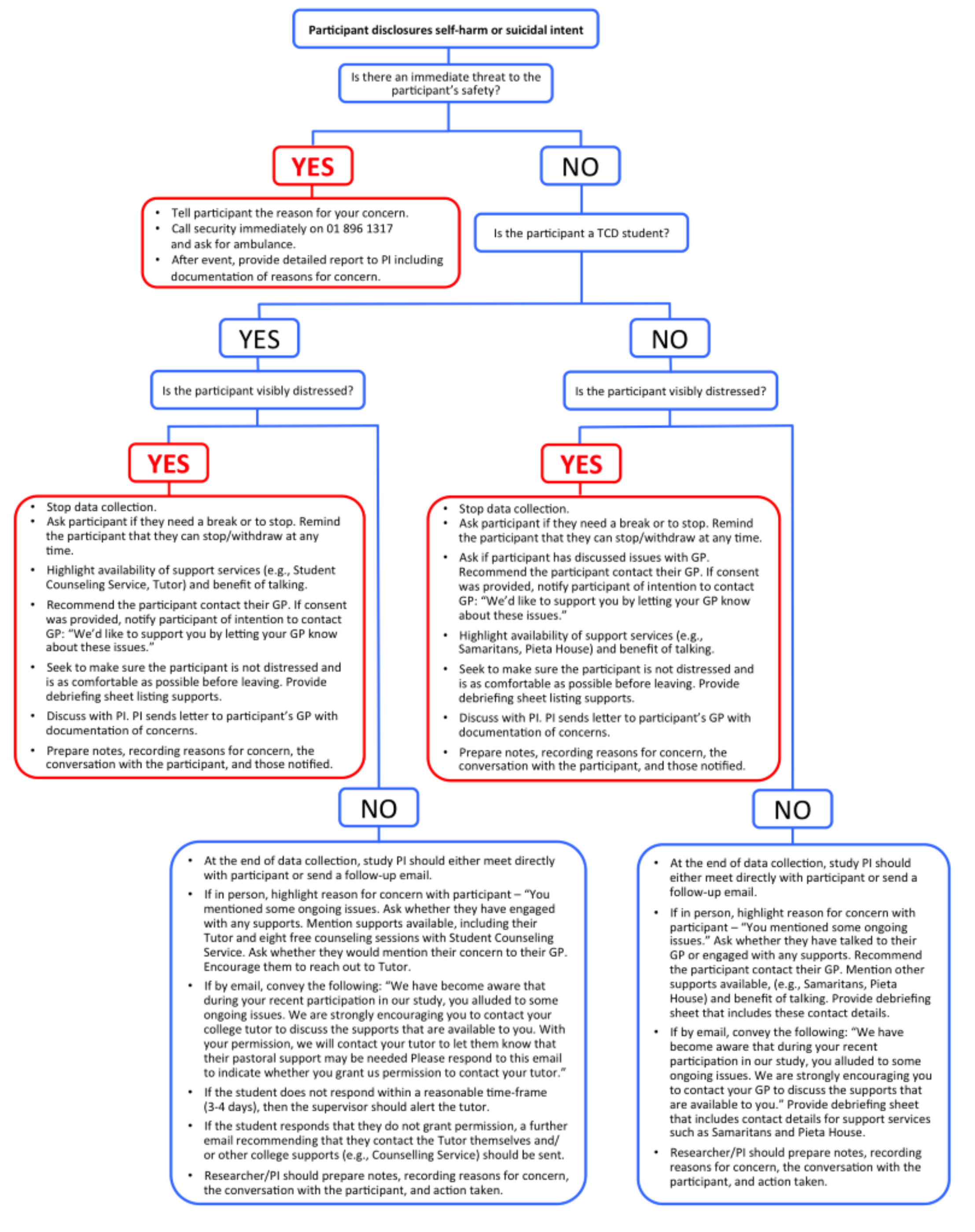
2. Immediacy of risk.

- Do the participant's words or actions suggest that they are at immediate risk – e.g., suicide plan is ready.

3. Availability of support services – what is the answer to the following questions?

- *"Are you in counselling?"*
- *"Are you in contact with a mental health service?"*
- *"Does anyone else know about these feelings?"*

4. Is the participant a TCD student or someone from outside the College?


Participant disclosures self-harm or suicidal intent
Is there an immediate threat to the participant's safety?
YES
NO
• Tell participant the reason for your concern.
• Call security immediately on 01 896 1317 and ask for ambulance.
• After event, provide detailed report to PI including documentation of reasons for concern.
Is the participant a TCD student?
YES
NO
Is the participant visibly distressed?
Is the participant visibly distressed?
YES
YES
• Stop data collection.
• Ask participant if they need a break or to stop. Remind the participant that they can stop/withdraw at any time.
• Highlight availability of support services (e.g., Student Counseling Service, Tutor) and benefit of talking.
• Recommend the participant contact their GP. If consent was provided, notify participant of intention to contact GP: "We'd like to support you by letting your GP know about these issues."
• Seek to make sure the participant is not distressed and is as comfortable as possible before leaving. Provide debriefing sheet listing supports.
• Discuss with PI. PI sends letter to participant's GP with documentation of concerns.
• Prepare notes, recording reasons for concern, the conversation with the participant, and those notified.
• Stop data collection.
• Ask participant if they need a break or to stop. Remind the participant that they can stop/withdraw at any time.
• Ask if participant has discussed issues with GP. Recommend the participant contact their GP. If consent was provided, notify participant of intention to contact GP: "We'd like to support you by letting your GP know about these issues."
• Highlight availability of support services (e.g., Samaritans, Pieta House) and benefit of talking.
• Seek to make sure the participant is not distressed and is as comfortable as possible before leaving. Provide debriefing sheet listing supports.
• Discuss with PI. PI sends letter to participant's GP with documentation of concerns.
• Prepare notes, recording reasons for concern, the conversation with the participant, and those notified.
NO
NO
• At the end of data collection, study PI should either meet directly with participant or send a follow-up email.
• If in person, highlight reason for concern with participant – "You mentioned some ongoing issues. Ask whether they have engaged with any supports. Mention supports available, including their Tutor and eight free counseling sessions with Student Counseling Service. Ask whether they would mention their concern to their GP. Encourage them to reach out to Tutor.
• If by email, convey the following: "We have become aware that during your recent participation in our study, you alluded to some ongoing issues. We are strongly encouraging you to contact your college tutor to discuss the supports that are available to you. With your permission, we will contact your tutor to let them know that their pastoral support may be needed Please respond to this email to indicate whether you grant us permission to contact your tutor."
• If the student does not respond within a reasonable time-frame (3-4 days), then the supervisor should alert the tutor.
• If the student responds that they do not grant permission, a further email recommending that they contact the Tutor themselves and/or other college supports (e.g., Counselling Service) should be sent.
• Researcher/PI should prepare notes, recording reasons for concern, the conversation with the participant, and action taken.
• At the end of data collection, study PI should either meet directly with participant or send a follow-up email.
• If in person, highlight reason for concern with participant – "You mentioned some ongoing issues." Ask whether they have talked to their GP or engaged with any supports. Recommend the participant contact their GP. Mention other supports available, (e.g., Samaritans, Pieta House) and benefit of talking. Provide debriefing sheet that includes these contact details.
• If by email, convey the following: "We have become aware that during your recent participation in our study, you alluded to some ongoing issues. We are strongly encouraging you to contact your GP to discuss the supports that are available to you." Provide debriefing sheet that includes contact details for support services such as Samaritans and Pieta House.
• Researcher/PI should prepare notes, recording reasons for concern, the conversation with the participant, and action taken.

Appendix B1 Data Tables Chapter 3 Confirmatory Factor Analysis

Table 1

Assessment of Normality - 41 Item ARBQ

Variable	min	max	skew	c.r.	kurtosis	c.r.
Q8i	1	5	-0.30	-3.86	-1.37	-8.77
Q8h	1	5	0.30	3.84	-1.38	-8.83
Q8g	1	5	-0.12	-1.50	-1.47	-9.41
Q8f	1	5	-0.01	-0.18	-1.29	-8.26
Q8e	1	5	0.45	5.71	-1.02	-6.53
Q6i	1	5	-0.59	-7.58	-0.31	-2.01
Q6b	1	5	-0.52	-6.69	-0.63	-4.02
Q5j	1	5	0.73	9.32	-0.31	-1.96
Q5h	1	5	-0.95	-12.20	0.13	0.85
Q5a	1	5	-0.20	-2.54	-1.18	-7.55
Q7i	1	5	1.07	13.76	0.59	3.78
Q8d	1	5	2.76	35.29	**8.13**	52.10
Q7h	1	5	2.80	35.93	**8.31**	53.23
Q7g	1	5	1.73	22.10	2.12	13.61
Q7f	1	5	0.90	11.53	0.13	0.85
Q7e	1	5	4.94	63.32	**26.17**	167.65
Q7d	1	5	4.20	53.86	**19.50**	124.90
Q7c	1	5	4.32	55.38	**21.33**	136.68
Q7b	1	5	1.09	13.98	0.95	6.11
Q7a	1	5	0.54	6.87	-0.83	-5.33
Q5b	1	5	0.54	6.95	0.29	1.89
Q5c	1	5	1.17	14.95	0.84	5.40
Q5d	1	5	0.49	6.21	-0.07	-0.43
Q5e	1	5	1.12	14.33	0.65	4.18
Q5f	1	5	0.90	11.50	-0.01	-0.09
Q5g	1	5	0.70	8.97	-0.14	-0.88
Q5i	1	5	1.59	20.38	2.04	13.04
Q5k	1	5	0.39	4.96	-0.41	-2.63
Q6a	1	5	-1.96	-25.10	4.26	27.26

Q6c	1	5	0.68	8.74	0.08	0.48
Q6d	1	5	0.27	3.48	-0.50	-3.22
Q6e	1	5	0.25	3.21	-0.38	-2.44
Q6f	1	5	0.52	6.61	-0.53	-3.39
Q6g	1	5	0.71	9.04	-0.31	-1.96
Q6h	1	5	0.53	6.77	0.02	0.11
Q6j	1	5	0.42	5.33	-0.77	-4.96
Q6k	1	5	0.65	8.30	-0.44	-2.84
Q6l	1	5	1.25	16.03	1.17	7.51
Q8a	1	5	0.68	8.73	0.34	2.21
Q8b	1	5	0.85	10.91	0.61	3.93
Q8c	1	5	0.71	9.11	-0.70	-4.46
Multivariate					**479.52**	**126.72**