Vision Australia
Blindness. Low Vision. Opportunity.

MONASH University

ACCIDENT RESEARCH CENTRE

4 December 2018

Senator Tim Storer
PO Box 6100
Senate
Parliament House
Canberra ACT 2600

Dear Senator Storer

Please find attached a new research report into the impact of electric / hybrid vehicles and bicycles on pedestrians who are blind or have low vision conducted by Monash University Accident Research Centre in collaboration with, and funded by Vision Australia.

As the nation's largest service provider to people who are blind or have low vision, Vision Australia is at the forefront of responding to existing and emerging needs of the blind and low vision community. This report was commissioned due to the increasing safety concerns of electric/hybrid vehicles for pedestrians who are blind or have low vision. Sound generated by vehicles has traditionally been an important sensory alert to improve independent mobility for pedestrians who are blind or have low vision.

The study revealed 35% of respondents experienced either a collision or near-collision with an electric/hybrid vehicle. The majority of incidents recorded by participants occurred in places where pedestrians have right of way.

People with disabilities can be significantly disadvantaged in the community, and in a car-centric country such as Australia, pedestrians who are blind or have low vision are particularly vulnerable on the road network. With recently available projections estimating that quiet road transport vehicles will make up 90% of the vehicle fleet by 2050, the number of people injured or killed due to being struck as they are unable to detect them will grow. The *Report* also makes the point that this issue will likely negatively impact the safety of young and older pedestrians, in addition to those who are blind or have low vision unless measures are taken to protect all road user groups.

The Australian Government has a significant opportunity to follow in the footsteps of regulatory authorities in the USA and Europe who moved swiftly to pass minimum noise standards for these vehicles when travelling at low speed. There is now a United Nations Regulation addressing this issue, and this was done in co-operation with vehicle manufacturers. This action by the United Nations, the United States, Europe and more recently Japan, China and Korea was done on the basis of three elements:

1. Research evidence that demonstrates silent vehicles represent a threat to pedestrian safety when travelling at low speed;
2. That the fitment of a device to emit a well-designed sound when silent vehicles travel at low speed is efficacious, and
3. That such sound-emitting devices fitted to vehicles is acceptable to consumers.

As a signatory to the 1958 United Nations Global Agreement concerning the Adoption of Harmonized Technical Regulations for Wheeled Vehicles, we urge the Australian Government to move rapidly

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toward a*dopting* ***UN Regulation No 138-01 on the approval of Quiet Road Transportation Vehicles.***

Adopting UN Regulation No 138-01 would ensure fitment and activation of an *Acoustic Vehicle Alerting System (AVAS)* on all hybrid and electric vehicles when travelling at low speed. This *Regulation* is the product of significant technical and policy research in Europe and the United States, who have adopted its own requirements (as is customary) to ensure a sound is emitted when electric and hybrid vehicles are travelling at low speed. We note that these *Regulations* are effective in these countries for vehicles manufactured from 2018 onwards. However, action is required to ensure that the same vehicle technology is fitted to vehicles sold in Australia. As AVAS is not listed in the ANCAP or Euro-NCAP roadmap, regulation through the *Motor Vehicle Standards Act* in the form of an Australian Design Rule (ADR) is required to ensure AVAS is fitted to new vehicles. A failure to do so will put an increasing number of pedestrians at risk.

As hybrid/silent cars will become the dominant vehicle type in time, we strongly believe that it is essential government adopt countermeasures to protect the wellbeing of all road user groups when designing and operating a safe road transport system. We note that adoption of this *Regulation* represents a unique opportunity for Australia to address what is already known to be a significant pedestrian safety concern. With only a small number of these vehicles in the current Australian fleet, adoption of UN Regulation 138-01 immediately represents a key opportunity to mitigate a known risk through proactive regulation. We therefore urge the Australian Government, as well as each State and Territory and Road Safety Stakeholders to consider this issue with urgency and to address this regulatory gap that has emerged by the introduction of electric / hybrid vehicles.

We would welcome the opportunity to meet with you to share the report recommendations that support improved safety for pedestrians who are blind or have low vision. We would welcome discussions with you and will be in touch to organise a time to meet. In the interim, if you have any questions or would like to suggest a time to meet, please do not hesitate in getting into contact with us, with our contact details noted below.

Yours faithfully,

Ron Hooton

Chief Executive Officer
Vision Australia

MONASH University

ACCIDENT RESEARCH CENTRE

Vision Australia

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The impact of electric / hybrid vehicles and bicycles on pedestrians who are blind or have low vision

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OCTOBER 2018

FORWARD

The research study titled “The impact of electric / hybrid vehicles and bicycles on pedestrians who are blind or have low vision” was commissioned by Vision Australia. This study was designed to gain a better understanding of the road safety experiences of people who are blind or have low vision. In particular, it aimed to specifically examine the challenges experienced by pedestrians who are vision impaired when navigating electric / hybrid vehicles, and bicycles during their everyday travel. The ability to travel safely and independently has significant implications for overall health and well-being. This report documents the findings from the study and outlines a range of recommendations to enhance road safety for pedestrians who are blind or have low vision, and more broadly, the pedestrian population.

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ACKNOWLEDGMENTS

Vision Australia and Monash University Accident Research Centre (MUARC) would like to thank Mrs Ann Gray for her generous donation that allowed for the commissioning of this important research.

The research team would also like to express their sincere gratitude to the blind and low vision community for the time and effort they provided in assisting with data collection. Thank you for sharing your experiences with us. Your contributions have been invaluable to the findings from this research.

Further we would also like to thank Vision Australia's Orientation and Mobility (O&M) instructors for their input into the design and development of the focus groups, and survey. Your expertise are greatly appreciated.

Lastly, the research team would also like to acknowledge Vision Australia for not only funding this research, but also their continued support in the conduct and delivery of this project. In particular, we would like to acknowledge Kirsty Simpson and Jamila Savoy, along with your supportive team. Your contribution and efforts have been central to delivering this project, which we hope will lead to policy changes that will not only enhance safety for the blind and low vision community, but pedestrians more broadly.

EXECUTIVE SUMMARY

INTRODUCTION

The ability to engage in independent travel is central to the overall health and well-being of human beings. Walking is a vital component of independent travel; being a major mode of transport, as well as a means of physical activity that has positive impacts on both physical and mental health. However, pedestrian trauma remains a significant concern in Australia, with statistics indicating that pedestrian fatalities and serious injuries are still at concerning levels. Pedestrians are considered to be vulnerable road users and at increased risk on roads due to their lack of protection and limited biomechanical tolerance to violent forces when impacted by a vehicle or other road users. This is particularly pertinent for pedestrians who experience functional impairments, where their ability to navigate the road network may be compromised. People who are blind or have low vision are a particular example of a pedestrian subgroup where safe mobility can be challenging.

In more recent times, the introduction of electric / hybrid vehicles has posed a significant navigating challenge for pedestrians who are blind or have low vision. In particular, these quiet vehicles are very difficult for this subgroup of pedestrians to detect and respond to, because they are unable to rely on their other sensory modalities such as hearing, to navigate when it is safe to cross roads. Similarly, detection concerns have also been raised about cyclists. With the likely increase in electric / hybrid vehicles moving forward, and promotion of active transport such as cycling, it is therefore important to establish a better understanding of the road safety concerns associated with these transport modalities, for pedestrians who are blind or have low vision.

Based on this, the overall aim of this research was to explore the impact of electric / hybrid vehicles, and cyclists on pedestrians who are blind or have low vision.

METHOD

There were three components to this research: literature review, focus group discussions and a community-based survey.

Literature Review: The literature review focused on establishing the background for the present research, and examined recent (within the last 10 years) national and international research on electric / hybrid vehicles. The aim was to better understand the risk to pedestrians who are blind or have low vision, and develop an overview of the current regulations for this vehicle fleet.

Focus Groups: Two focus group workshops were conducted to collect qualitative data on the research themes of interest. Participants were aged 18 years and over, and were either blind or with low vision. One focus group was conducted face-to-face with participants from Victoria only. A second focus group was conducted via telephone / video conferencing with participants across Australia.

Community-based Survey: An online community-based survey was developed to examine the road safety experiences of pedestrians who are blind or have low vision. In particular, specific emphasis was placed on their collision or near-collision experiences with electric / hybrid vehicles and bicycles. A total of 246 participants accessed and completed the survey. Data was collected via Qualtrics, and analysed using the IBM Statistical Package for Social Sciences (SPSS) V. 25 for Macs.

Findings from the three components were synthesised to develop a series of recommendations that are believed to enhance road safety for pedestrians who are blind or have low vision.

RESULTS

Findings from the two focus groups revealed the following:

- All participants reported some degree of difficulty in detecting electric / hybrid vehicles as a pedestrian. There was consensus that the majority of participants felt increased vulnerability on roads, as a result of electric / hybrid vehicles being present.
- The majority of participants reported concern about collisions and near-collisions with cyclists, particularly on shared pathways. Similar to that of electric / hybrid vehicles, participant reflected that they find it difficult to detect and avoid cyclists.
- Participants highlighted the beneficial nature of orientation and mobility (O&M) training, particularly related to developing strategies to establish routine, utilise other sensory modalities and the ability to identify markers in the environment.
- Mental health related issues such as reduced confidence and increased anxiety were highlighted by participants.
- When asked about countermeasures to improve their safety, participants highlighted raising public awareness and educating drivers and other road users as one of the most important actions moving forward. One particular theme was to communicate to the general community that people who are blind or have low vision are not always easily identifiable, particularly if they are not utilising any assistive aids.

Findings from the online community-based survey found:

- The majority of participants (75%) reported that they regularly walk (daily or almost daily), with just under a third of the participant sample indicating they walk on average, over 10km each week.
- Of the participant sample, 42% reported that they mainly walk outside unassisted. When asked about instances where participants walked outside assisted, the largest proportion of respondents (45%) indicated they used a white cane, followed by being accompanied by another person (26%).
- The usefulness of mobile phones and Apps to assist in remaining safe whilst walking was also assessed. Of the total participant sample, one-third indicated that they felt it has no impact, 55% indicated some impact, whilst a further 11% reported that mobile phones had a high impact on their ability to remain safe whilst walking.
- Of the total participant sample, 35% reported having experienced either a collision or near-collision with an electric / hybrid vehicle. And of these

individuals, 14% reported at least one collision, 77% reported at least one near-collision, with a further 9% reported having experienced at least one collision and one near-collision.

- Further, 74% of respondents indicated that the introduction of electric / hybrid vehicles onto Australian roads has reduced their confidence to walk and cross roads.
- Of the total participant sample, 78% reported having experienced either a collision or near-collision with a cyclist. And of these individuals, 19% reported at least one collision, 65% reported at least on near-collision, and a further 16% indicated that they had experienced at least one collision and one near-collision.
- Further 75% of respondents indicated that cyclists on the roads reduced their confidence to walk and cross roads.
- With respect to participants who reported collision or near-collision experiences, 40% indicated that this had impacted on their travel patterns.
- The majority of the sample reported fair to excellent health. However, 53% indicated some level of reduced mood, whilst 87% reported experiencing worry related to walking or crossing roads.
- Participants were asked about their level of support for a range of countermeasures. Raising community awareness regarding the safety impact of electric / hybrid vehicles and cyclists on pedestrians who are blind or have low vision was the most strongly supported countermeasure. This was followed by increasing the noise threshold of electric / hybrid vehicles.

CONCLUSIONS AND RECOMMENDATIONS

Based on the overall findings, it is evident that pedestrians who are blind or have low vision are at an increased risk when engaged in active travel such as walking. The study has identified that a significant proportion of respondents indicated having experienced collisions or near-collisions with both electric / hybrid vehicles and cyclists. This finding is of particular concern with the anticipated increase in the electric / hybrid vehicle fleet moving forward, in Australia. Given the significant impact active travel has on overall health and well-being, it highlights the importance of ensuring that pedestrians who are blind or have low vision remain empowered to continue walking. In order to support continued mobility, the following recommendations have been proposed:

Vehicle-based recommendations:

- Given Australia’s stated preference to harmonise vehicle safety standards with Europe, immediately adopt UN Regulation No 138-01 on the approval of *Quiet Road Transportation Vehicles* (QRTV) to ensure fitment of an *Acoustic Vehicle Alerting System (AVAS)* on all hybrid and electric vehicles.
- Promote the Regulation and accelerated uptake of advanced driver assistance systems (ADAS), including Auto Emergency Braking (AEB), Collision Evade Assist, and collision-warning systems using radar, lidar and DSRC-based detection systems.

- Explore the use of vehicle-to-pedestrian warning based systems, including DSRC technologies, which provide early warning of vulnerable pedestrians to vehicle drivers.

Infrastructure-based recommendations:

- Provide extended pedestrian crossing times at signalised intersections, and ensure all signalised intersections include audio-tactile pedestrian push button assemblies.
- Provide for controlled pedestrian crossings in high pedestrian areas, and those with high density for pedestrians who are blind or have low vision.
- Provide directional and warning Tactile Ground Surface Indicators (TGSIs) to assist pedestrians who are blind and have low vision in crossing the road safely.
- Road authorities to consider safety improvements such as raised platforms and lower speeds at roundabouts and turn slip-lanes, as these present unique difficulties for pedestrians who are blind or have low vision.
- Road authorities ensure alignment of path landings to ensure ease of crossing roads in a straight-line insofar as possible.
- Promote the retrofitting of road infrastructure features outlined in *Accessibility Guidelines* in locations found not to comply (see for example, VicRoads Traffic Engineering Manual, Volume 3 – Additional Network Standards and Guidelines: Accessibility (DDA) Guidelines, 2017).

Road-user behaviour recommendations:

- Conduct an activity mapping study of a sample of people who are blind or have low vision using wearable technologies to identify common travel patterns and locations, in order to identify safety improvements.
- Conduct a large-scale education program across multiple channels (i.e., print, radio, social media) highlighting the need for vehicle drivers to demonstrate safe road use behaviours when interacting with pedestrians.
- Introduce a practical component into Orientation and Mobility training to assist people who are blind or have low vision to recognise the unique sounds of electric and hybrid vehicles.

Broader community-based recommendations:

- Increase community awareness via education of the safety risks experienced by pedestrians who are blind or have low vision. It is important to highlight the road user needs of pedestrians who are blind or have low vision.
- Develop psychological support-based networks for people who are blind or have low vision as part of continuing to promote active living and mobility.

1.0 INTRODUCTION

1.1 BACKGROUND OVERVIEW

According to the World Health Organisation (WHO, 2017), there are an estimated 253 million people who live with vision loss, 36 million who are blind and 217 million who have moderate to severe vision loss. In Australia more specifically, statistics indicate that there are over 380,000 people who are currently blind or have low vision (Vision Australia, 2016). The annual economic cost attributable to blindness and vision loss has been estimated to be AUD$16 billion, with further social and personal costs to be considered (Tong, Duff, Mullen, & O'Neill, 2015).

In particular, research has suggested that compared to the general population, people who are blind or have low vision experience four times the rate of unemployment, suffer twice as many falls, have three times the risk of depression, are admitted to residential care three years earlier and often lose confidence to independently manage everyday life (Tong et al., 2015). The latter has significant implications for the overall physical and mental well-being of these individuals.

Independent travel is a part everyday life for humans and the ability to experience safe mobility is fundamental to independent functioning. However, the degree of vision loss can require different skills and strategies necessary as a pedestrian, to navigate the complex road network of multiple road user groups. In fact, some earlier Australian research conducted by the Monash University Accident Research Centre (MUARC) identified that safety is a concern for pedestrians who are blind or have low vision, with a high proportion experiencing collisions or near-collisions (Liu, Oxley, Bleechmore, & Langford, 2012; Oxley, Liu, Langford, Bleechmore, & Guaglio, 2012a; Oxley et al., 2012b). Further, these individuals also reported reduced confidence in their ability to engage in independent travel.

Given the well recognised relationship between independent travel and overall health and well-being, it is crucial to consider the potential barriers that limit pedestrians who are blind or have low vision in achieving this goal. In the context of road safety, a range of considerations from road infrastructure, assistive technologies to vehicle developments need to be examined.

1.2 RESEARCH RATIONALE

As highlighted, pedestrians who are blind or have low vision are exposed to increased risk when utilising our road network to travel independently. In particular, there has been growing concern since the introduction of electric / hybrid vehicles, which post significant challenges associated with detection. Pedestrians who are blind or have low vision rely more heavily on other sensory systems such as hearing and touch. With advances in technologies, motor vehicles such as cars are being equipped with quieter engines, which in turn makes it more difficult for pedestrians to recognise oncoming traffic, let alone those who are blind or have low vision.

To date, there has been limited research documenting the impact of electric / hybrid vehicles on the mobility of people who are blind or have low vision in Australia. Whilst it is recognised that these vehicles may contribute to greater detection challenges, along with increased crash risk; there is a need to directly examine the experiences that pedestrians who are blind or have low vision have had with electric

/ hybrid vehicles. This will likely inform countermeasures necessary to enhance their safety. Hence, this was the primary focus of the present research. Further, the impact of bicycles on the travel experiences of people who are blind or have low vision will also be considered given the similar challenges associated with detection.

1.3 AIMS AND OBJECTIVES

To summarise, the overall aim of the proposed research is to explore the impact of electric / hybrid vehicles on pedestrians who are blind or have low vision. Further, the impact of bicycles will also be considered. More specifically, the research objects are:

1. To better understand the common problems associated with travel for this population (including those using assistance dogs) that are a direct result of electric / hybrid vehicles and bicycles.
2. To estimate the prevalence of collisions and near-collisions with electric / hybrid vehicles and bicycles.
3. To explore mental health and psychological impact that electric / hybrid vehicles and bicycles have on this population (i.e., confidence, anxiety and depression).
4. To provide recommendations on possible countermeasures that will increase safety on the road for pedestrians who are blind or have low vision.

1.4 SCOPE

This research comprises three components. The first component is the literature review, which will examine both national and international literature available on pedestrian safety, and more specifically the impact of electric / hybrid vehicles on the travel experiences of pedestrians who are blind or have low vision. The second component encompasses two focus groups designed to gather qualitative and anecdotal experiences of people who are blind or have low vision. In particular, the aim is to identify the challenges and barriers to safe travel. Lastly, the third component comprises a community survey to investigate more broadly, the travel patterns of pedestrians who are blind or have low vision, and also quantify their experiences with collisions and near-collisions with electric / hybrid vehicles and bicycles.

Taken together, the results will form a discussion around the current road safety issues associated with electric / hybrid vehicles and bicycles for pedestrians who are blind or have low vision, and highlight opportunities to apply a range of countermeasures to enhance safety.

2.0 METHOD

This section details the methods used for each component of the study.

2.1 ETHICS

Ethics approval was obtained from the Monash University Research Human Research Ethics Committee (MUHREC) for the conduct of this study.

2.2 LITERATURE REVIEW

The literature review was designed to provide a detailed understanding of up to date literature in the area to be investigated. A rapid review was completed, including both national and international literature. Grey literature was also included. Only articles and reports that were produced from 2009 until present were included in the literature review. The main focus of the literature review was on electric / hybrid vehicles. The literature review is provided in Section 3.0.

2.3 FOCUS GROUPS

2.3.1 PARTICIPANTS

Two focus groups were conducted in total. The first focus group was Victoria-based and in-person comprising eight participants (note: one participant joined via teleconference). The second focus group was Australia-wide via video / teleconference and comprised fourteen participants. In order to be eligible to take part in the focus groups, participants were aged 18 years and over, and had some degree of vision loss that cannot be corrected.

2.3.2 FOCUS GROUP THEMES

Across both focus groups, six themes were identified as topics for discussion. These themes were developed in conjunction with Orientation & Mobility (O&M) instructors at a scoping workshop, prior to the conduct of the focus groups. The themes discussed included:

1. The impact of electric / hybrid vehicles on pedestrians who are blind or have low vision:
    - Safety considerations associated with electric / hybrid vehicles.
    - Experiences with collisions or near-collisions.
2. The impact of bicycles or cyclists on pedestrians who are blind or have low vision:
    - Safety considerations associated with bicycles or cyclists.
    - Experiences with collisions or near-collisions.

3. Occupational and mobility (O&M) training:
    - Training received from O&M instructors.
    - Specific skills that are used to assist navigating electric / hybrid vehicles and bicycles / cyclists.
4. Assistive technologies:
    - Specific aids that may be used to assist navigating electric / hybrid vehicles and bicycles / cyclists.
5. Mental health
    - Confidence to engage in independent travel.
    - Independence and self-efficacy.
    - Depression, anxiety and travel phobia.
6. Countermeasure suggestions to reduce risk and increase safety
    - Vehicle development options
    - Road infrastructure options
    - Assistive aids and technology options
    - Training and skill development options

2.3.3 PROCEDURE

The opportunity to participate in the focus groups was advertised by Vision Australia. A Victorian-based in-person focus group was conducted on the 20th of June 2018 from 7pm to 9pm. An Australian-wide video / telephone conferencing focus group was conducted on the 25th of June 2018 from 7pm to 9pm. Participants were reimbursed with a $100 gift card as a token of appreciation for their time taken. Further, for the in-person focus group, travel costs were also covered.

The focus group discussions were guided by the themes outlined above, and voice-recorded in order to enable transcription and analysis.

2.3.4 DATA ANALYSIS

Qualitative methods were used to analyse the results from the focus groups. The main themes identified are highlighted and discussed in Section 4.0.

2.4 COMMUNITY SURVEY

2.4.1 PARTICIPANTS

A total of 368 participants accessed the survey. Of these individuals 246 (67%) were eligible to complete, and completed the survey. In order to be eligible to participate in the online community survey, participants were required to be aged 18 years and over, in addition to having some degree of vision loss that cannot be corrected.

2.4.2 SURVEY THEMES

The survey was designed to examine a range of themes to capture road safety experiences of pedestrians who are blind or have low vision. The survey comprised six sections including:

1. Vision and hearing loss
2. Travel information
3. Walking and mobile phone use
4. Collision and near-collision involvement
5. Countermeasures
6. Demographics

The complete survey is provided in Appendix B.

2.4.3 PROCEDURE

The online survey was built using the Qualtrics platform and tested to ensure accessibility requirements for people who are blind or have low vision were met. Participants were also informed that they could contact a representative at Vision Australia (phone number was provided) should they wish to get assistance with completing the survey.

The opportunity to participate in the survey was advertised by both Vision Australia and Monash University via snowballing, and social media outlets.

2.4.4 DATA ANALYSIS

Upon completion of data collection, the data file was extracted from Qualtrics and analysed using the IBM Statistical Package for Social Sciences (SPSS) V. 25 for Macs. The main results are provided in Section 5.0.

3.0 LITERATURE REVIEW

3.1 THE BENEFITS OF WALKING

There is extensive research to support the fact that physical inactivity can increase the risk of a range of diseases including diabetes, cardiovascular disease, and some cancers (Kelly, Murphy, & Mutrie, 2017). It follows that active commuting and the engagement in regular walking becomes a protective factor for overall health and well-being (Andersen, 2017). Further, a strong positive relationship has been identified between walking and both physical (Warburton & Bredin, 2017) and psychological (Bailey, Allen, Herndon, & Demastus, 2017; Vancampfort et al., 2017) health. Whilst it is recognised that there are a range of positive outcomes associated with walking, pedestrians remain vulnerable road users, and therefore pedestrian trauma needs to be considered and mitigated in order to promote active lifestyles amongst the general community.

3.2 PEDESTRIAN SAFETY

At present, vulnerable road user trauma remains a significant concern in road safety. Pedestrians in particular, are considered particularly vulnerable largely due to their lack of protection and limited biomechanical tolerance to violent forces when impacted by a vehicle or other road user. This is further exemplified for particular pedestrian sub-groups including children, the elderly and pedestrians with functional impairments, such as those who are blind or have low vision.

Based on data from the Victorian Injury Surveillance Unit (VISU, 2018), the number of pedestrians who presented at an emergency department due to a collision with a car, pick-up truck or van within the last five years (2012 to 2017) was 2,152. Further, 4,060 individuals were admitted to hospital due to a collision with a car, pick-up truck or van within the last five years (2012 to 2017). In addition to collisions with a car, pick-up truck or van, 134 pedestrians who collided with a cyclist also presented at an emergency department within the same time period. These numbers suggest that pedestrians remain at risk when sharing the road network with other road users, and in particular experience more significant injuries when colliding with larger vehicles. Whilst an attempt was made to identify specific prevalence rates of collisions for pedestrians who are blind or have low vision, no research could be found documenting this. One of the limitations relates to the ability to identify in the hospital data, those with vision loss.

In more recent times, there has been increasing concern related to the introduction, and gradual rise in the presence of electric / hybrid vehicles within the Australian vehicle fleet. This poses a significant safety risk to pedestrians who are blind or have low vision because it creates a greater challenge for successful detection when they are crossing roads. This has significant implications for the overall mobility and general well-being of this pedestrian subgroup, and is therefore an area that requires further investigation.

3.3 ELECTRIC / HYBRID VEHICLES

3.3.1 THE ELECTRIC / HYBRID VEHICLE FLEET

The number of electric vehicle sales in Australia continues to grow, however they represent only a small proportion of the total number of vehicles sold per annum. While the percentage growth is similar to that seen overseas, the penetration of electric vehicles lags behind other countries (ClimateWorks, 2018; Energeia, 2018 [Table 1]).

According to the ClimateWorks (2018) report conducted for the *Electric Vehicle Council* (http://electricvehiclecouncil.com.au/resources/), *The state of electric vehicles in Australia - Second Report: Driving Momentum In Electric Mobility,* despite year-on-year growth, plug-in hybrid and battery electric vehicles comprise 0.2% of the Australian market. Private buyers represent only one-third of all electric vehicle purchasers with government purchasing accounting for 3%; thus, 63% of electric vehicle purchasers were private sector businesses. This growth has reportedly been driven by an increase in the number of available electric vehicle models (16 in 2016 to 23 in 2017), improvements in travel range, and an increase in the number and accessibility of charging stations (ClimateWorks, 2018). The price-point of electric vehicles continues to remain high, however with the maturation of technology and increased competition in the market, the price is anticipated to reduce, thus improving accessibility.

The number of electric vehicles globally and in Australia is projected to increase, with cumulative estimates of over 500 million electric vehicles sold globally by 2040. In Australia, there are a range of initiatives to promote electric vehicle use (see Table 4, Overview of federal, state and territory government policy, ClimateWorks, 2018; Energeia, 2018: Table 3).

With moderate government intervention via incentives and other regulations, Energeia (2018) predicts that:

- Plug-in electric vehicles will reach 615,000 vehicles per annum by 2030, increasing to 1.89 million annual new vehicle sales by 2040, or 49% and 100% of sales respectively.
- As a proportion of all vehicles on the road, electric vehicles will equate to 15%, 55% and 90% of the entire vehicle fleet in 2030, 2040 and 2050 respectively.
- Increased will be driven by lower vehicle prices, improved and cheaper battery performance, more models on offer, and price benefits compared to traditional petrol engine vehicles.

While Australia has yet to set a deadline for banning the sale of traditional internal combustion engines, a number of jurisdictions have done so, including Norway, the UK, Germany and France, among others (Energeia, 2018).

In sum, while the number of electric vehicles in Australia currently represents a small proportion of the vehicle fleet, it is inevitable that the number of these vehicles in the fleet will grow rapidly to become the dominant vehicle type. The implications for pedestrian safety are obvious, with concerns raised of the impacts of electric / hybrid vehicles on pedestrian safety, particularly for pedestrians who are blind or have low vision. Recognising this, action has been taken at the global level to ensure the safety of pedestrians in the presence of electric / hybrid vehicles.

3.3.2 ADDRESSING PEDESTRIAN SAFETY CONCERNS AND REGULATIONS

Global action to address pedestrian safety concerns of quiet electric vehicles

Safety concerns regarding the interaction between pedestrians with electric and hybrid vehicles have been expressed more than a decade ago, first in the United States and then in Europe. Regulatory authorities in the US and Europe have moved quickly with Regulations being passed concerning minimum noise standards for electric and hybrid vehicles when travelling at low speed. The intention of these Regulations is to improve pedestrian safety, particularly pedestrians who are blind or have low vision. To date, these Regulations are yet to be adopted in Australia.

This section provides an overview of the principal considerations and outlines the regulatory requirements for vehicles

Background and early moves to address pedestrian safety and quiet vehicles

As early as 2003, and following the introduction to the United States of the second generation *Toyota Prius* at the April New York International Auto Show (Schaffels, 2003), the increased risk to pedestrians of these vehicles – particularly to those with vision loss, were being discussed.

At its July 2003 Convention, the US National Federation of the Blind (www.nfb.org) passed Resolution 2003-05 ('Quiet Cars') expressing '…*its deep concern that the safe and free travel of blind pedestrians and all pedestrians may be significantly and increasingly impaired by quiet vehicles, a problem that will grow as such vehicles become more prevalent'.* The NFB called on the US National Highway Traffic Safety Administration (NHTSA) to examine safety impacts and to explore potential solutions (Pierce, 2003). As outlined by Stein (2005), the 2003 Convention also called for the NFB to highlight its concerns with governments and that 'a device integrated into the design of each car which will generate a noise sufficiently loud to allow for the detection of these automobiles using nonvisual techniques' (Stein, 2005). Stein (2005) also suggested that pedestrians could also carry an auditory or haptic device that would signal the presence of a vehicle; this is discussed below in relation to advanced dedicated short-range communication technologies (DSRC) now available. It need to be noted that the US National Federation of the Blind continued to make resolutions concerning quiet cars (2008) and was an active participant in various committees in the US to progress the issue.

Acting on these concerns, as well as other emerging activities, NHTSA convened a public meeting in June 2008 in Washington to seek information from stakeholders on the safety of blind pedestrians encountering quiet cars (Federal Register, 2008). The notification to the public of the meeting specifically noted concerns raised by Stein (2005) and the increasing number of hybrid vehicle sales and the high pedestrian crash-involvement rate. NHTSA also noted its work since 2007 with the Society of Automotive Engineers International (SAE) to address pedestrian safety aspects of quiet vehicles, including the addition of artificial sounds to vehicles through the newly established Vehicle Sounds for Pedestrians (VSP) sub-committee; this committee included a representative from the American Council for the Blind and NHTSA. This research highlighted the significant difference in detection of vehicles when travelling at low speed and recommended the use of an external noise emitting system (Goodes, Bai, Meyer, 2009).

The notification of the NHTSA public meeting also noted that the NFB had commissioned the University of California-Riverside to investigate the ability of people to detect hybrid vehicles. This work vindicated the concerns expressed, with hybrid vehicles found to be very difficult to detect, and only detected at close range compared to normal internal combustion engine (ICE) vehicles (Rosenblum, 2008; Robart & Rosenblum, 2009).

Further to this activity, in 2009, the United States Congress enacted legislation known as the *Pedestrian Safety Enhancement Act of 2008.* This *Act* required steps to be taken to develop a vehicle safety standard that provides a means for blind and other pedestrians to be alerted to the presence of quiet vehicles (United States, 2008). Ultimately this has led to the development of United States Federal Motor Vehicle Safety Standard (FMVSS) No. 141, Minimum Sound Requirements for Hybrid and Electric Vehicles (United States, 2016), with phase-in requirements from September 1, 2018 and full compliance is required on September 1, 2019. This requires a sound emitting device to be added to all electric vehicles according to specified criteria before the vehicle can be sold.

Global technical solutions and Regulations

Given the moves of the United States and awareness of some vehicle manufacturers to the issue of pedestrian detection of quiet vehicles (e.g., Motavalli, New York Times, 2009), regulatory activity commenced from 2010 onwards in a number of countries and in the European Commission. It is not possible, nor is it necessary here, to document the extensive process that has been undertaken in the development of *Regulations* pertaining to noise emission devices to address the risk quiet vehicles pose to pedestrians, particularly those who are blind or vision impaired. Rather, key points are noted here:

- The United States, Japan, Korea and China, and the European Union have active research and development programs to establish regulations designed to arrive at uniform requirements for sound emission for quiet vehicles for the protection of pedestrians. This has meant that a number of different Regulations exist, although common to each the requirement to emit an audible sound when vehicles are travelling at low speed. A summary of different Regulations was published by the International Organization of Motor Vehicle Manufacturers (OICA) (Worldwide comparison of Regulations - see slide 19)
- Simplistically, most countries abide by the global United Nations Regulations on Vehicle Safety, including Australia. United Nations Regulations fall under what is known as the ‘1958 Agreement on Uniform Requirements for Vehicles’ and the ‘1998 Agreement – Global Technical Regulations’.
    - Australia has a stated preference to harmonise its vehicle safety regulations with those of the United Nations Economic Commission for Europe (UNECE), and is done so locally under the guise of *Australian Design Rules (ADR)* through the *Motor Vehicle Standards Act 1989 (see https://infrastructure.gov.au/vehicles/design/).* This preference to harmonise with the UNECE has important implications – and positives, for the adoption of the new UN Regulation to address the safety of pedestrians in the presence of quiet vehicles. Adoption of any UN Regulation requires legislation to be passed by the Australian Parliament, before which a *Regulatory Impact Statement* is normally undertaken.

    - The most relevant Regulation for Australia is UN Regulation 138-01 (see Appendix A). Under this Regulation, a sound is required to be emitted from electric vehicles when travelling up to and including 20 km/h. In this Regulation, there is no allowance for a 'pause' button on the emitted noise, as is the case with the EU Regulation (Regulation (EU) No 540/2014) although unlike the US FMVSS Regulation, there is no noise directionality component.
    - Note, the United States maintains a separate regulatory regime known as the US Federal Motor Vehicle Standards (FMVSS) through the US Department of Transportation, but collaborates with the UN Regulatory bodies.
        - As noted above, sound requirements for vehicles sold in the United States are governed by US FMVSS 141, which requires sounds to be emitted when quiet (i.e., hybrid, electric) vehicles are travelling up to 30 km/h.
- Regulations require sound emitting devices to be fitted to new electric vehicles models introduced for the first time from 2018 and 2019, depending on jurisdiction. Application of the Regulations to all electric vehicles sold, including currently available models, occurs 1 to 2 years after these dates depending on phase-in requirements.
- Given differences in the available Regulations, efforts are being made to develop a harmonised *Global Technical Regulation (GTR)* under the '*1998 Agreement'.* This would overcome some of the current discrepancies seen in the different regulations, mainly as it applies to speed of onset and cut-off, pause switch allowance and directionality of tones. This work is on-going through the Unite Nations Working Party 29 (WP 29). Representations can be made to the Informal Working Group (GTR for QRTV) which is separate to already active UN Regulation No. 138 under the '1958 Agreement'). The 6th Meeting for the development of the GTR was held in May 2018 in Baltimore. It can be noted that there was no representative from the Australian Government at this meeting.

For the interested reader, extensive information on the development of the United Nations the Regulation on Quiet Road Transport Vehicles (QRTV) can be found at the UN WP.29 website: https://wiki.unece.org/display/trans/GTR+for+QRTV. Here, the Agenda of each meeting and associated materials can be found, including presentations from governments, manufacturers, research organisations and stakeholders, including the World Blind Union who have played an important advocacy role in the design of the Regulations (see for example submission to 61st GRB, 27-29 January 2015, agenda item 11; http://www.unece.org/fileadmin/DAM/trans/doc/2015/wp29grb/GRB-61-15e.pdf).

Future refinements of the UN Regulation

Enhancements to UN Regulation 138-01 discussed have been alternative non-acoustic measures, including active safety system vehicle features, such as pedestrian detection systems. Whether this means manufacturers might have a choice in which measures to use is unknown. It can be noted that alternative measures are sometimes proposed when manufacturers or other interested parties argue the same pedestrian crash reduction benefit can be achieved through a different means. Were the AVAS not used in favour of an alternative, this has implications for the accessibility of pedestrians who are blind or have low vision. In MUARC's view, the introduction of an alternative in place of the ACAS would be a regressive step, but as an *addition,* is welcomed to further improve pedestrian safety, particularly those with hearing impairments.

In the development of UN Regulation No. 138, requirements for powered two-wheelers and light 4-wheeled vehicles [<550 kg, electric] to include AVAS was discussed. This remains an on-going Agenda item in the refinement and development of the Regulation and also the proposed UN Global Technical Regulation, which is on-going as noted. However, it is likely that AVAS fitment will be required on these vehicles in the future.

Implications and actions for Australia

Adoption of UN Regulation 138-01 is recommended for the protection of pedestrians who are blind or who have vision loss, given the following:

- An increase in the number of electric vehicles in Australia, and their likely accelerated growth into the future;
- Evidence of differences in the detection of quiet vehicles and vehicles with internal combustion engines at low speed;
- The efficacy of artificial sounds in improving the detection of electric vehicles, and
- Continuing high pedestrian crash-involvement rates.

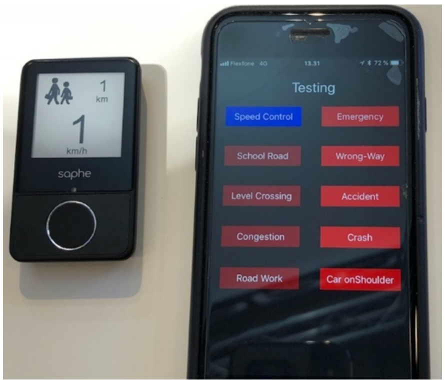
Whilst a UN Global Technical Regulation is under development, the timeframe for this is unknown. Adoption of UN Regulation 138-01 (*Acoustic Vehicle Alerting System*) would likely deliver considerable safety benefits for all pedestrians, as has been shown to be the case in Europe and in the United States with comparable systems. Given this, it is recommended that immediate action be taken by Australia and its constituent States and Territories to implement this vehicle safety requirement.

3.3.3 DEVELOPING TECHNOLOGIES

New vehicle-based technologies such as Auto Emergency Braking (AEB), Collision Warning Systems, and Collision Evade Assist, will all likely play an important role in reducing pedestrian-involved crashes. While none of these systems are currently subject to *Regulation,* the fitment of AEB into vehicles has been heavily promoted by the New Car Assessment Program (NCAP; see: http://www.globalncap.org/). It is likely that the newer technologies (collision warning, collision evade assist) will also become core technologies in future vehicles. These technologies currently rely on radar and lidar systems with continuous improvements being made constantly. The potential benefits of these technologies in preventing pedestrian and other collisions is likely to be high, and hence, further work needs to be undertaken to ensure their adoption into new vehicles.

Within road safety more generally and vehicle safety specifically, considerable emphasis has been placed on vehicle-to-vehicle (V-V) and vehicle-to-infrastructure (V-I) technology. A new innovation is the vehicle-to-person (V-P) technology, made possible by newer technologies using Dedicated Short-Range Communication (DSRC) devices. These small devices, if fitted across vehicles and incorporated into technologies such as mobile phones or worn by pedestrians and cyclists, can create a network that informs road users of the presence of one another. It is highly likely that this technology will become the mainstay of V-V, V-I and V-P communications, ensuring high levels of safety in the future when combined with vehicle warning and braking systems.

By way of example, show-cased at the 25th *Intelligent Transport Systems (ITS) World Congress* in Copenhagen (17-21 September, 2018) was a DSRC device designed by Saphe (https://saphe.dk/).



The DSRC device when paired with an iPhone or other system can inform drivers of hazards such as pedestrians, cyclists and crashes (see photo image). DSRC devices can be fitted to bicycles, worn by pedestrians, or potentially fitted to collars of guide dogs or embedded within walking canes. This represents an additional 'use-case' for this type of technology. The Saphe device is currently available in Europe.

In summary, active vehicle safety technology is evolving rapidly. It is likely that vehicle-based systems will play a key role in ensuring the safety of all pedestrians, through warning the driver of the presence of other road users and taking over control when the driver fails to respond. It is strongly recommended that the fitment of active safety systems including AEB, collision warning and collision evade assist be mandated under Regulation as an Australian Design Rule. This will ensure fitment of these technologies into all vehicles. Additionally, further research and efforts to ensure the fitment of DRSC devices into vehicles and for use by all road users is recommended. Combined with the AVAS, there is considerable scope to ensure the safety of all pedestrians in an electric vehicle future.

3.3.4 ENGINEERING ACCESSIBILITY STANDARDS

Infrastructure Standards play an integral role in the provision of roads, roadsides, footpaths and associated street furniture. For instance, VicRoads (2017) Accessibility Guidelines specify requirements for footpath width, path alignment, and path cross-fall with wheelchair access in mind. Similarly, the application of Tactile Ground Surface Indicators (TGSIs) and audio-tactile pedestrian push button assemblies, among other features to benefit pedestrians with low vision or who are blind. Adherence to these Standards in all new road environments is demanded, whilst there is a case to retrofit these Standards to existing infrastructure where pedestrians are present.

Overseas research has also pointed to the difficulties posed by roundabouts and channelized turn lanes, given the preference for 'orthogonal direction of movement' of pedestrians who are blind or have low vision; that is, left/right, forward/back. Considerable work has been undertaken in this area by the US National Cooperative Highway Research Program, with Report 674 focussed on *Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities*

(Schroeder et al., 2011). A number of solutions are highlighted in this *Report,* and a number of Recommendations are made on the basis of these.

To conclude, roadway infrastructure plays a crucial role in ease of access for all road users, but particularly pedestrians who have vision loss. Consideration of the Standards and Guidelines is necessary to ensure compliance with anti-discrimination requirements, but also to provide ease of use for all members of the community.

4.0 FOCUS GROUP WORKSHOPS

This section provides an overview of the main themes from the two focus groups conducted.

4.1 THE IMPACT OF ELECTRIC / HYBRID VEHICLES

The discussion surrounding the impact of electric / hybrid vehicles on pedestrians who are blind or have low vision centred around the importance of these vehicles emitting a detectable level of noise.

> *"I need the traffic noises. I need to know where the traffic is*
>
> *"If you can't see them or hear them, how can you know they are even there?"*
>
> *"Hybrid vehicles need to have some sort of noise to assist pedestrians to detect it."*

There was general consensus that this is particularly important when pedestrians who are blind or have low vision are travelling across driveways, or crossing roads.

> "*If you can't hear the car, you don't know when it's safe to cross."*

Participants reflected on the particular challenges associated with detecting these vehicles at low speed. It was also highlighted that those cars where the engine turn off when stopped can also cause issues during crossing manoeuvrers, because they also cannot be detected.

It was evident in the focus group discussions that pedestrians who are blind or have low vision are at increased vulnerability on the roads. Some of their challenges navigating the road environment include crossing at roundabouts, slip lanes and unsignalised crossings.

> *"Slip lanes are difficult to navigate. You can't hear them coming around the corner and you are not sure if they are going to stop."*
>
> *"Parallel traffic on the road can mask the noise of oncoming cars at slip lanes."*

Further, even at signalised crossing, participants reported concern for their safety due to inadequate timing allocated to complete the crossing manoeuvre.

> *"Lights are not long enough. They don't give you enough time to cross over."*

With the introduction, and gradual increase in electric / hybrid vehicles, it is clear that the consensus is that this adds another layer of difficulty for the vision impaired community. When asked to reflect on how this has impacted on their travel behaviours, respondents appear to report that whilst they do feel concern, they have no option but to continue travelling despite feeling less safe on the roads.

> *"You just go out and hope for the best."*
>
> *"You take your life in your hands, really."*
>
> *"It doesn't decrease the amount we go out because we have to."*

"The introduction of electric cars means that I am more cautious because I'm aware that I may not be hearing everything and that does add a degree of stress and anxiety that wasn't there before."

4.2 THE IMPACT OF BICYCLES AND CYCLISTS

The discussion surrounding the impact of bicycles or cyclists on pedestrians who are blind or have low vision identified a similar theme to that of electric / hybrid vehicles and the difficulty in detecting them due to limited noise emitted by bicycles. Participants particular noted issues on shared pathways, and at crossing locations.

"When crossing the road, they can come around after the light or in front of the light."

"Noise on bikes would be a good idea."

Worthy of note is that a number of participants reflected on their experiences with collisions and / or near-collisions with cyclists. Many acknowledged that cyclists coming from behind often are not aware that some pedestrians may be unable to detect them, particular those that have limited hearing in addition to vision loss.

"They don't always know your vision impaired."

Participants also reflected on concern for the speed of cyclists on shared pathways. In fact, shared pathways with cyclists were identified as particularly challenging for pedestrians who are blind or have low vision.

4.3 ORIENTATION AND MOBILITY (O&M) TRAINING

Participants were asked about their experiences with O&M training, and the type of strategies that they are taught that specifically relate to detection of electric / hybrid vehicles or bicycles, both of which are difficult to detect due to minimal noise emitted. The general consensus was that O&M training did not specifically target how to navigate electric / hybrid vehicles or bicycles but entailed more generic skills to assist in remaining safe on the roads. Some of the common strategies included sticking to a routine, counting driveways and steps, and utilising the sense of touch to orient themselves.

"*I establish a routine for where I walk and I stick to that routine."*

"I count the driveways and steps. I also feel the fences."

The majority of participants reported having engaged in O&M training but also identified a lot of their skills were established through their own experiences.

4.4 ASSISTIVE TECHNOLOGIES

Participants that identified using a white cane or a Seeing Eye Dog reflected that they were more detectable by road users, as a result. However, those who reported not using any aids or assistive technologies were often faced with situations where other road users could not detect they were vision impaired.

“When I use a cane, other people are a lot more aware.”

A discussion surrounding potential assistive technologies that could assist with detection of electric / hybrid vehicles particularly, raised the idea of sensors on cars that produced sounds to alert pedestrians, and also potentially mobile Apps that might assist in communicating that electric / hybrid vehicles are within close proximity. The majority of participants reported that these sorts of assistive technologies would be useful for them.

4.5 MENTAL HEALTH

Given the increased road safety challenges experienced by pedestrians who are blind or have low vision, one theme that was also explored was the impact on their travel patterns and further, their mental health. Participants were asked to reflect on whether the introduction and gradual increase of electric / hybrid vehicles had impacted on their mental health and overall well-being.

“It doesn’t stop me from doing things but it makes me think more about doing them, as I am doing them.”

“Sometimes my behaviour is changed. Some days it’s just too much.”

“I have narrowly escaped some incidents.”

It is apparent that participants reported an increased hypervigilance and concern for their safety, that results in elevated levels of stress when travelling on the road network. The majority reported having experienced collisions or near-collisions, and identified that these experiences have impacted on their confidence to travel independently.

“Safety can impact on your confidence.”

This highlights a significant overall well-being concern for pedestrians who are blind or have low vision.

“I think when it comes to road safety, the worry is justified and you shouldn’t have to sacrifice that worry to be out in the world.”

4.6 COUNTERMEASURES

Lastly, countermeasures were discussed, where participants were asked to propose any suggestions they may have to enhance their safety with respect to electric / hybrid vehicles and bicycles. One of the main themes that came across was to increase the awareness of the general community. Educating both the general community, and more specifically drivers and cyclists that not all pedestrians are able to see them is important.

“Education for drivers about pedestrians who are blind or have low vision.”

“Need to take into consideration that people with vision impairment may have other impairments.”

"I think bringing awareness about the blind and low vision community at any time is incredibly helpful and useful. There are people in your community who are walking around and cannot see as well as you can."

The notion that all road users are equally responsible was also brought up. Participants highlighted the importance of a shared responsibility to keep each other safe.

With respect to road infrastructure, reduced share pathways and increased signal crossings were identified. Further the idea of speed reduction in high pedestrian areas was also proposed. In addition, the implementation of an audible indicator on all vehicles that is activated when a vehicle is reversing or coming out of a driveway was also proposed to enhance safety. Most countermeasures raised were specifically relevant to pedestrians who are blind or have low vision, but it was also noted that they would also have a safety impact on the broader pedestrian population.

5.0 COMMUNITY SURVEY

This section provides an overview of the findings from the online community survey titled “the impact of electric / hybrid vehicles on bicycles on road safety”. The results will be presented in sub-sections detailing participant characteristics, travel patterns, walking and mobile phone use, collision and near-collision involvement, health and well-being considerations, in addition to support for a range of potential countermeasures.

5.1 PARTICIPANT CHARACTERISTICS

5.1.1 DEMOGRAPHICS

The participant sample comprised of 246 respondents who all indicated a degree of vision loss that cannot be corrected by glasses or contact lenses. Of the total sample, 42% reported being male and 58% reported being female. The overall mean age was 54.88 years (*SD=16.47 years)*, and more specifically 56.21 years *(SD=16.77 years)* for males and 54.03 years *(16.25 years)* for females. Figure 5.1 provides an overview of the participant sample across the different age categories. Half the sample were aged between 45 and 64 years.

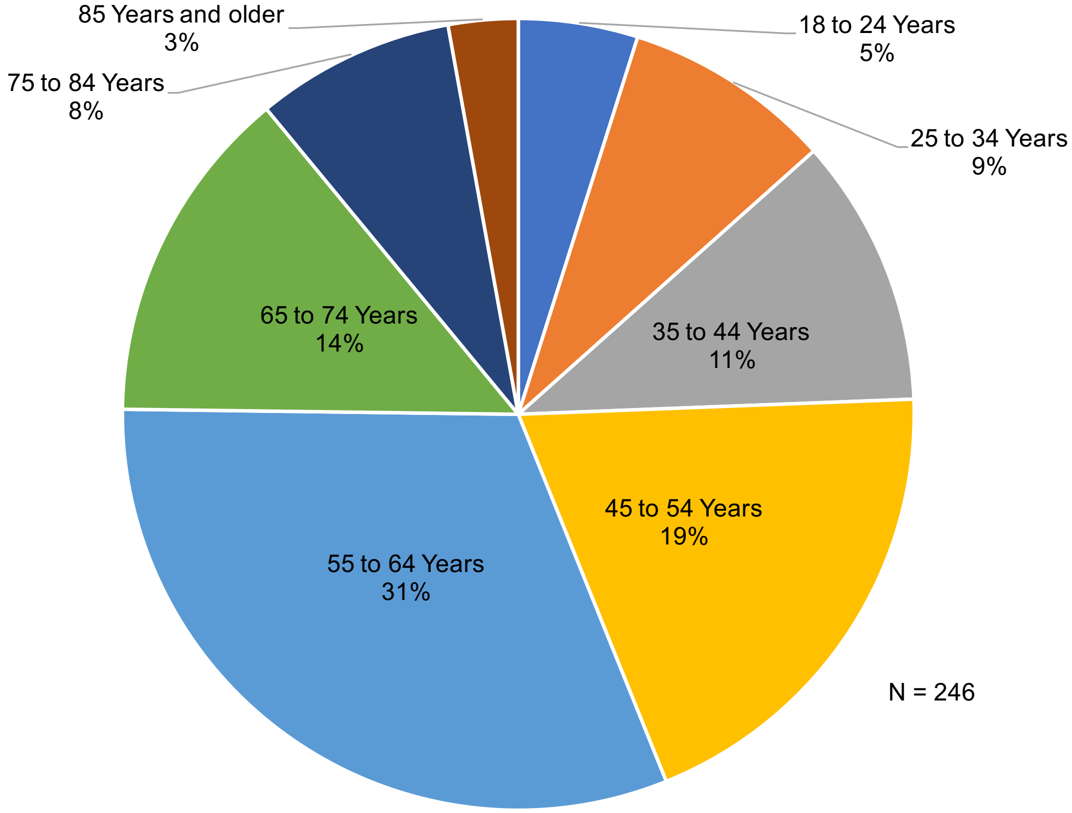


Figure 5.1 Distribution of participant sample across age categories

When asked about their employment status, 32% of participants reported working either full-time, part-time or casually, 16% indicated that they were not working (or unemployed), 31% reported that they were retired, 7% were studying and an additional 15% indicated that they were engaged in volunteer work. In total, 30% of participants lived alone whilst the remainder of the sample reported living with at least one other person.

5.1.2 VISION AND HEARING LOSS

Participants were asked about their level of vision and hearing loss. Of the total sample, 155(63%) reported low vision (i.e., unable to drive a car, great difficulty reading print material, difficulty recognising people), 44(18%) indicated severe low vision (i.e., not able to use printed material at all and having a strong preference for information in audible or brailed format), 22(9%) reported no useable vision, and a further 25(10%) indicated total blindness (i.e., no light perception).

Hearing loss was reported by 66(27%) participants in the total sample. Of these, 9(14%) reported slight hearing loss, 12(18%) indicated a mild level, 35(53%) reported a moderate level and a further 10(15%) indicated a severe to profound level of hearing loss. Figure 5.2 illustrates the proportion of individuals with some level of hearing loss, relative to their level of vision loss. Almost three-quarters of those who indicated hearing loss, also had low vision.

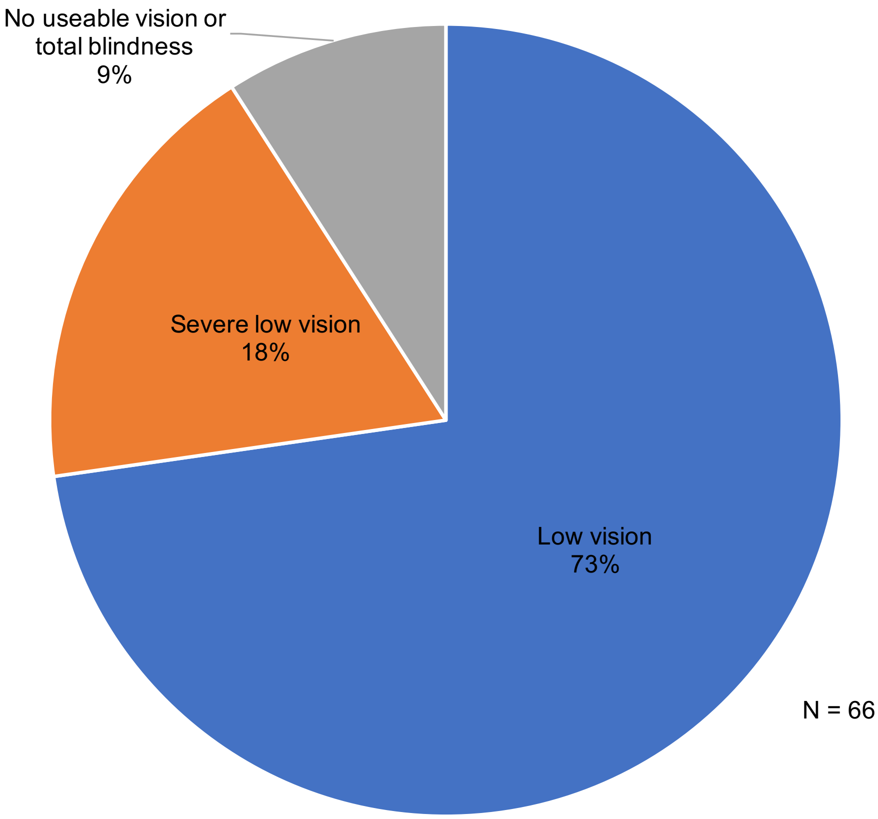


Figure 5.2 Proportion of participants with hearing loss relative to their degree of vision loss

Participants were also asked about the age at which they first experience both vision and hearing loss. Table 5.1 summarises the proportion of individuals who indicated initial vision or hearing loss across age categories. Of those that reported hearing loss, 42(64%) indicated having worn a hearing aid when walking outside, and of these individuals, 30(70%) felt that it helped them better detect vehicles and bicycles.

Table 5.1 Number and proportion of participants who indicated initial vision or hearing loss across age categories

Age Category	Vision Loss n(%)	Hearing Loss n(%)
At birth	81(33%)	<5
17 Years and younger	53(22%)	7(11%)
18 to 24 Years	7(3%)	6(9%)
25 to 34 Years	22(9%)	<5
35 to 44 Years	17(7%)	6(9%)
45 to 54 Years	23(9%)	15(23%)
55 to 64 Years	21(9%)	16(24%)
65 Years and older	21(9%)	9(14%)
Total (N)*	246(100%)	66(100%)

**Note: Missing data was indicated for one respondent for both vision and hearing loss age.*

5.2 TRAVEL PATTERNS

Participants were asked a series of questions to better understand their level of mobility and travel patterns. First participants were asked about the frequency in which they walk outside of their home. The majority of respondents 185(75%) reported that they walk either daily or almost daily. Figure 5.3 shows the frequency of walking relative to their level of vision loss. Whilst over three-quarters of participants within both the low and severe vision group still reported walking daily or almost daily, only two-thirds of those who indicated no useable vision or total blindness indicated doing so. This suggests reduced mobility for these individuals who experience a significantly higher level of vision loss.

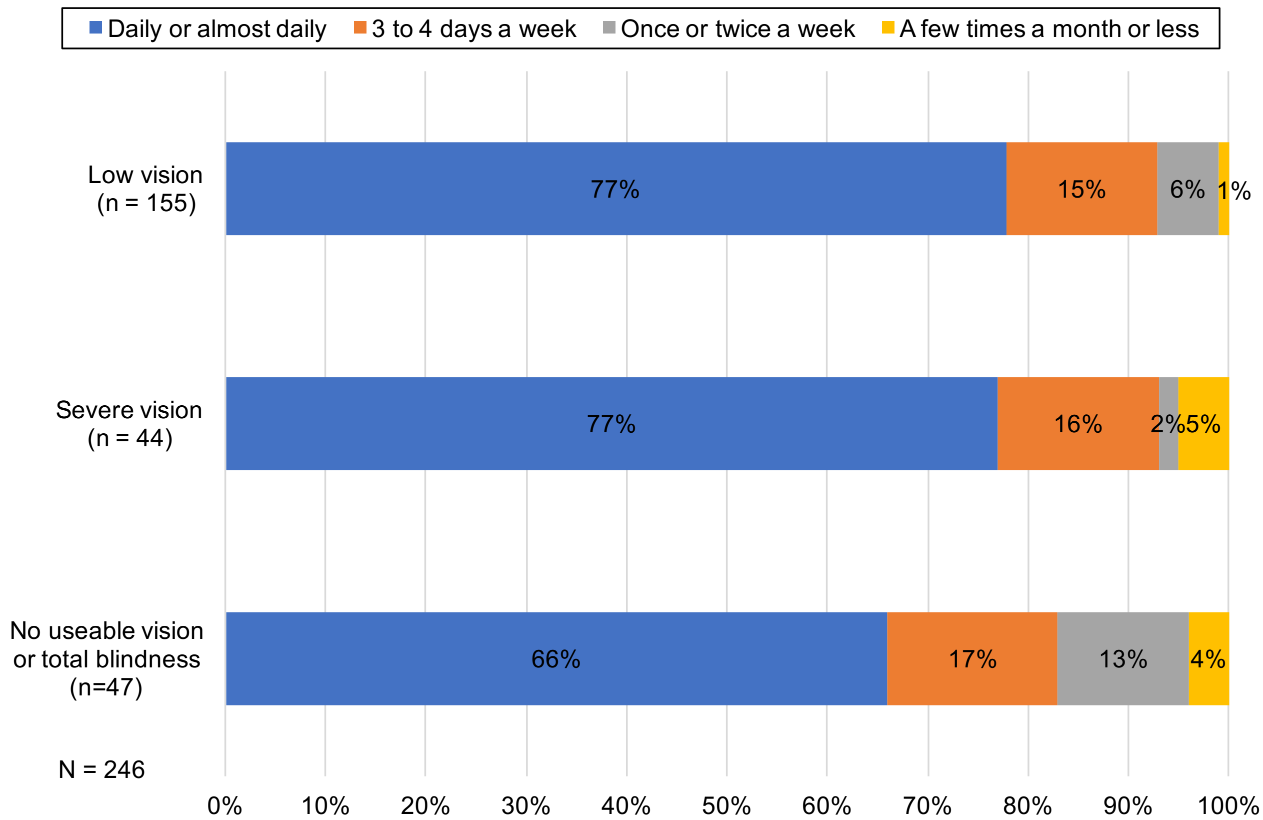


Figure 5.3 Frequency of walking relative to level of vision loss

Of interest was also how far participants normally walk each week. A total of 38(15%) participants reported walking less than 2km, 199(48%) reported walking between 2km and 10km, and a further 76(31%) reported that they walked more than 10km on average each week. More specifically, distance travelled was examined relative to level of vision loss. Figure 5.4 illustrates the average amount in kilometres walked each week, relative to the level of vision loss. It appears that the distribution across different vision loss levels remains comparable, with the exception of the severe vision loss group. A larger proportion of individuals within this group reported walking more than 10kms per week on average. It is also worthy to note that a substantial proportion of individuals with no useable vision or total blindness still appear to be walking a significant distance despite their frequency of walking being reduced relative to the other two vision loss groups.

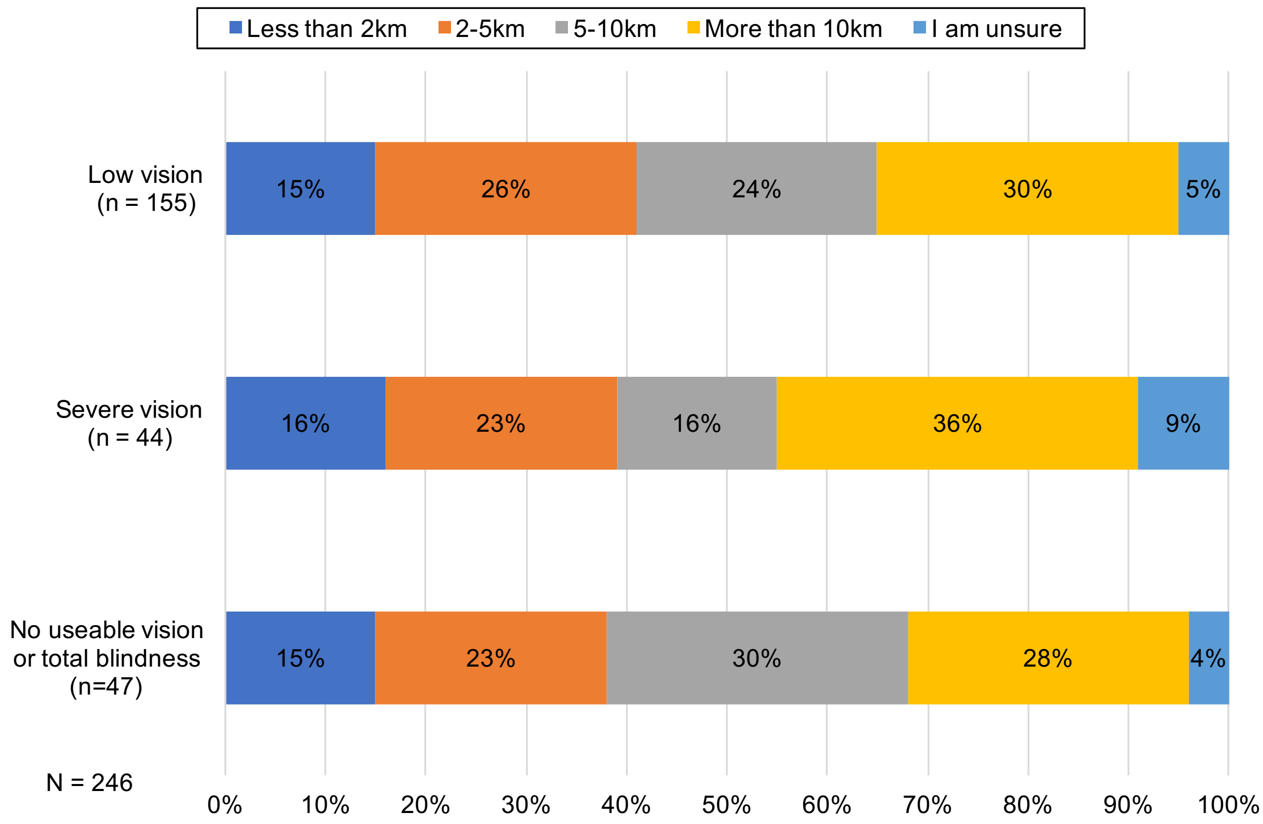


Figure 5.4 Average kilometres walked each week relative to level of vision loss

Under half of the participant sample 104(42%) reported that they walk outside unassisted by another person, mobility aid (such as a white cane) or a Seeing Eye Dog (Guide Dog) most of the time. In contrast, 62(25%) respondents indicated that they never walk outside unassisted. When asked about the main type of assistance used whilst walking assisted, the largest proportion of respondents 110(45%) indicated that they use a mobility aid (such as a white cane), whilst 30(12%) reported being assisted by a Seeing Eye Dog (Guide Dog), and 12(5%) indicated using both. A further 65(26%) participants reported that they mainly walk with another person, in contrast to 29(12%) other respondents who reported never walking outside assisted.

It was also of interest to examine the motivations for walking across the participant sample. Participants were provided with a range of different options. Figure 5.5 provides an overview of the frequency in which participants reported different main reasons for walking. Most respondents 191(78%) reported running errands as one of their main reasons for walking, followed closely with accessing public transport (175, 71%). The least common responses were visiting a church or place of worship (31, 13%) and education or training (39, 16%).

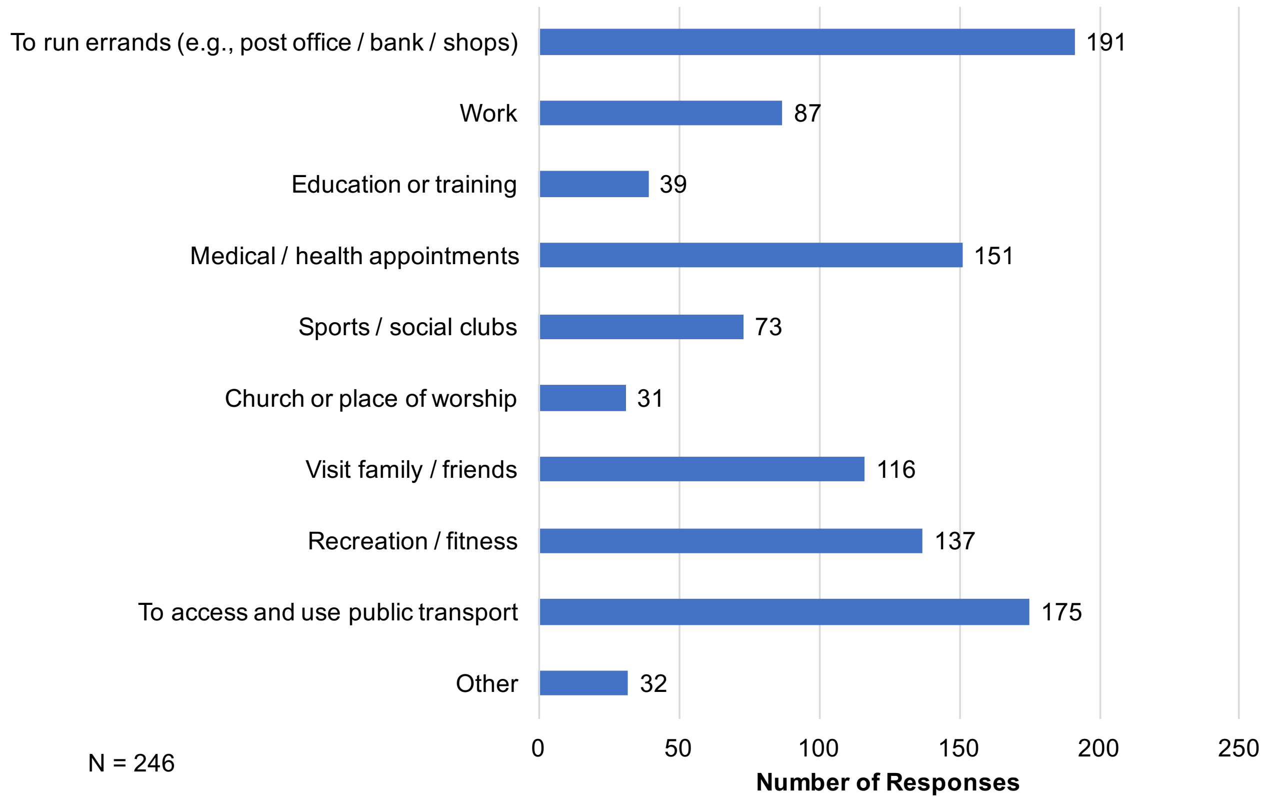


Figure 5.5 Main reasons for walking reported by participants

With respect to travel patterns, participants were lastly asked to consider whether their walking frequency had changed relative to 5 years ago. Whilst 81(33%) participants reported walking more, and 62(25%) reported walking about the same amount, 97(40%) revealed that they were walking less. This suggests that two-fifths of the sample indicated reduced walking patterns. Whilst a range of reasons were offered by participants who reported walking less, themes included fear, safety concerns, deteriorating vision or health, in addition to changes in circumstances (e.g., no longer working).

5.3 WALKING AND MOBILE PHONE USE

Mobile phones or smart phones have the potential to assist pedestrians who are blind or have low vision to navigate during their travel. In particular, a range of different map programs (or Apps) can guide pedestrians on their walking route. Of the total sample, just under half (112, 46%) of the participants reported that they use their mobile phone when walking. Of these individuals, the majority (87, 35%) reported that they "sometimes" used their phones.

Of further interest was how those who used mobile phones, engaged with them whilst walking. In total, 31(28%) participants reported that they read the screen with their eyes, whilst the remainder indicated that they either listened to the phone's audio output using the speaker (43, 38%) or used earphones / headphones to head the audio output (38, 34%). When asked about their behaviour whilst crossing the road, the majority of those who indicated using a mobile phone while walking (93, 83%) reported that they always put their phone away or remove their earphones / headphones prior to crossing the road. A further 14(13%) participants reported only sometimes doing so, and another 5(4%) participants indicated rarely or never doing so.

Given the prolific development of Apps for mobile phones, participants were asked whether they used any to assist their navigation. Of the total number of individuals who reported smart phone use, 88(79%) reported having used an App to support navigation at some point.

Lastly, participants were asked overall, whether they felt the use of their mobile phone whilst walking assisted with their ability to remain safe. Around one third of respondents who used mobile phones (37, 33%) reported that they felt it had no impact on their ability to remain safe and over half (62, 55%) indicated it had some impact. However, it is important to note that 13(11%) participants reported their mobile phone use has a high impact on their ability to remain safe, so much so that they feel they are often distracted using their mobile phone and would be better off not using it whilst walking.

5.4 COLLISION AND NEAR-COLLISION INVOLVEMENT

There have been limited data detailing the collision or near-collision involvement with electric / hybrid vehicles and bicycles for pedestrians who are blind or have low vision. One of the key elements of the present study was to gain an idea of prevalence for these occurrences, which have significant safety implications. Given the significant impact that these experiences can have on an individual's physical and mental health, it is essential that an improved understanding of the risk is established.

Firstly, participants were asked about their collision experiences within the last five years. Of the total sample, 194(79%) reported that they had been in at least one collision or near-collision, of which 34(18%) respondents indicated that they had been involved in at least one of each. Figure 5.6 illustrates the proportion of individuals who reported total number of collisions and near-collision experiences within the last five years. A total of 70(28%) participants reported at least one collision experience in the last five years, whilst 158(64%) individuals indicated being involved in at least one near-collision. Noteworthy is the fact that of those who had been in collisions, 13% reported having been involved in five or more, and of those who reported having been involved in near-collisions, 39% reported five or more experiences.

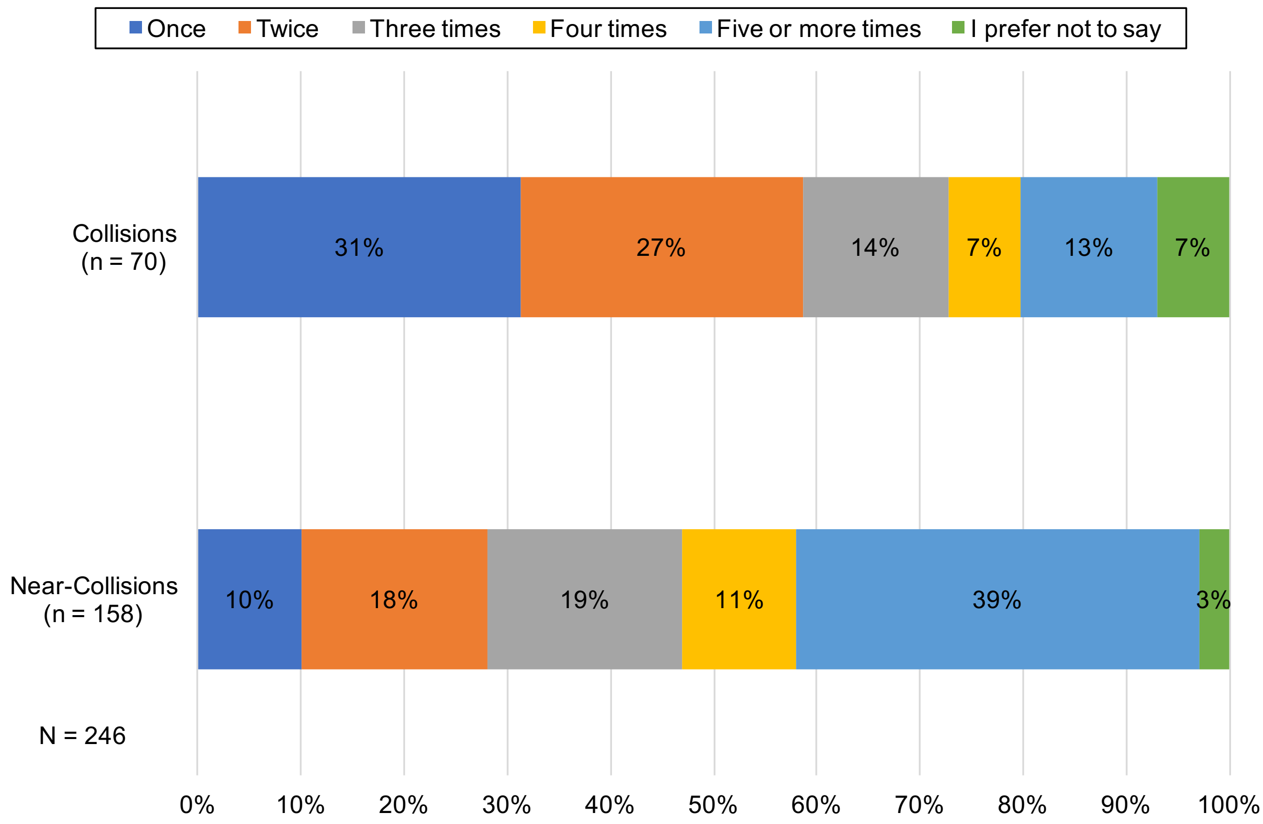


Figure 5.6 Proportion of participants with total number of collisions or near-collisions with the last five years

5.4.1 ELECTRIC / HYBRID VEHICLES

As a central theme being investigated in the present study, electric / hybrid vehicles (also known as silent cars) pose a significant safety risk for pedestrians who are blind or have low vision due to challenges in detecting these vehicles which emit minimal, if any, sound. When asked about collisions or near-collisions with an electric / hybrid vehicle, 86(35%) participants indicated they had experienced at least one, of which 12(14%) reported involvement in a collision, 66(77%) indicated involvement in a near-collision, and a further 8(9%) reported having experienced at least one of each with an electric / hybrid vehicle. Figure 5.7 illustrates the proportion of collision and near-collision experiences with electric / hybrid vehicles relative to level of vision loss. Whilst the majority reported near-collisions across all three vision loss groups, the severe vision loss group reported the highest experience with either a collision, or both a collision and near-collision experience. When also considering hearing loss, of those participants who reported exhibiting some degree of hearing loss, 20(30%) indicated having experienced either a collision, near-collision or both at some point.

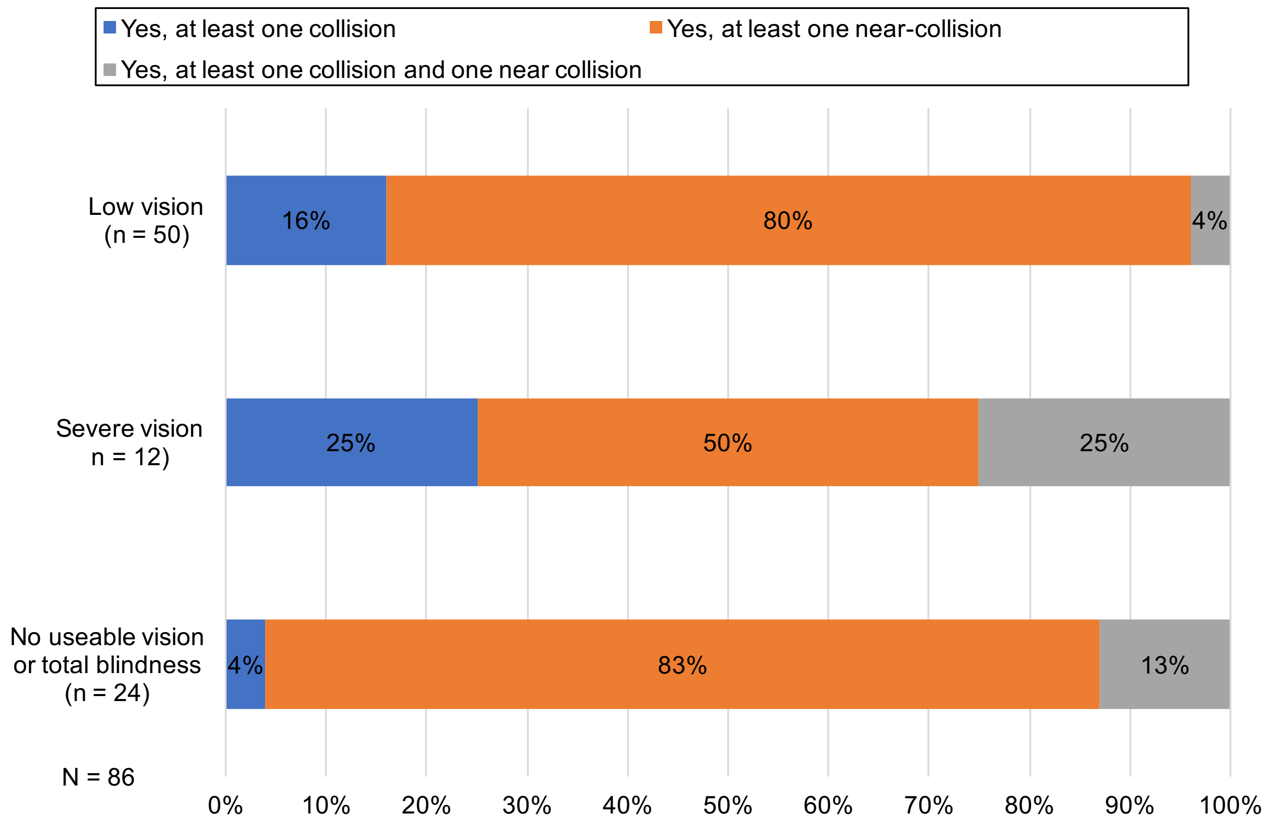


Figure 5.7 Proportion of collisions and near-collisions with electric / hybrid vehicles for participants who indicated having experienced this

To gain an indication of recent collision or near-collision experiences with an electric / hybrid vehicle, participants were asked whether the most recent incident occurred within the last 12 months. A total of 23(27%) reported that their most recent collision experience with an electric / hybrid vehicle was within the last 12 months, whilst a further 39(45%) reported their near-collision experience was within the last 12 months. When asked to assess how confident they were that the collision or near-collision was with an electric / hybrid vehicle, almost three-quarters (62, 72%) reported extreme confidence.

Understanding the contextual factors in which the collision or near-collision occurred is essential to developing countermeasures aimed at enhancing the safety for pedestrians who are blind or have low vision. Of those who reported having a collision or near-collision experience, the most common location in which respondents' last incident occurred was within a metropolitan suburban area (48, 56%). A further 18(21%) respondents reported metropolitan CBD, with the remaining (20, 23%) indicating either regional or rural country areas.

When participants were asked about where they were travelling on the road network at the time of their collision or near-collision, varied responses were indicated. Figure 5.8 summarises these findings, with walking along the footpath being the most common response, followed by crossing the road at a (zebra) crossing, then at an intersection without audible traffic lights and subsequently at an undesignated crossing location.

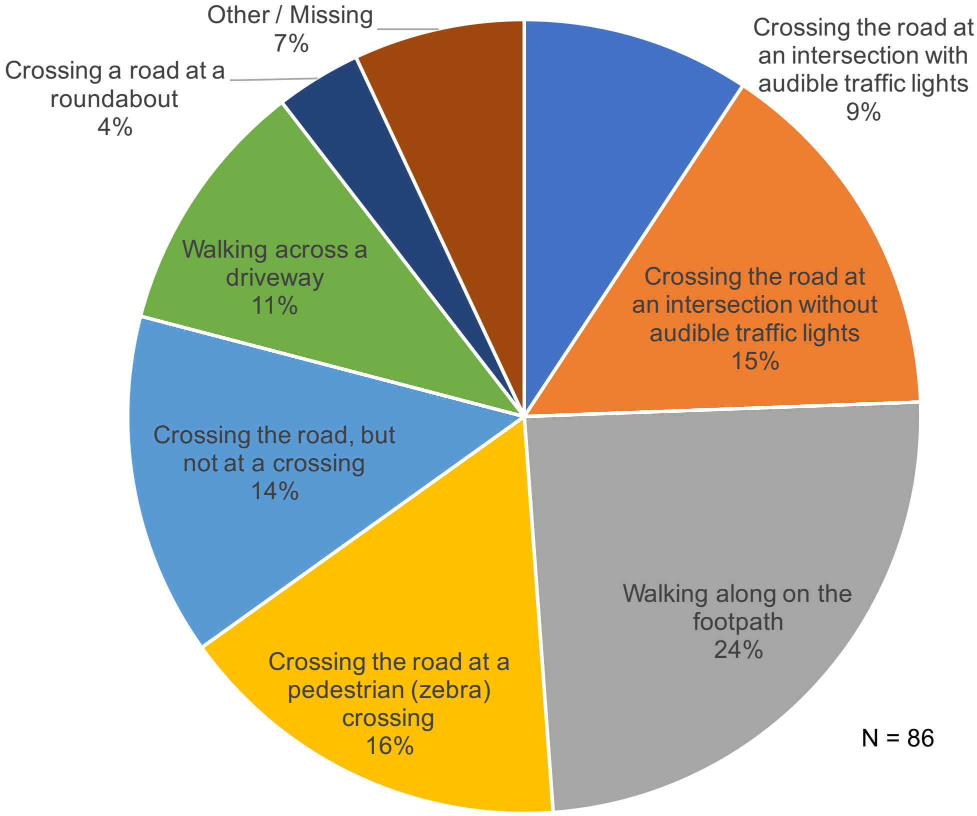


Figure 5.8 Proportion of participants at various walking locations at the time of collision or near-collision with electric / hybrid vehicle

Participants were also asked if they were accompanied or assisted at the time of the collision or near-collision. Figure 5.9 summarises the number of individuals that reported being alone, in the company of others or assisted. Of those who reported that they were alone (36, 42%), less than five reported they were accompanied by a Seeing Eye Dog, a further 10 respondents indicated they used a white cane, and less than five reported using a mobility aid. The results indicate that despite being in the company of others, a Seeing Eye Dog (Guide Dog), or assisted by the use of a mobility aid, participants still reported collisions or near-collisions with electric / hybrid vehicles.

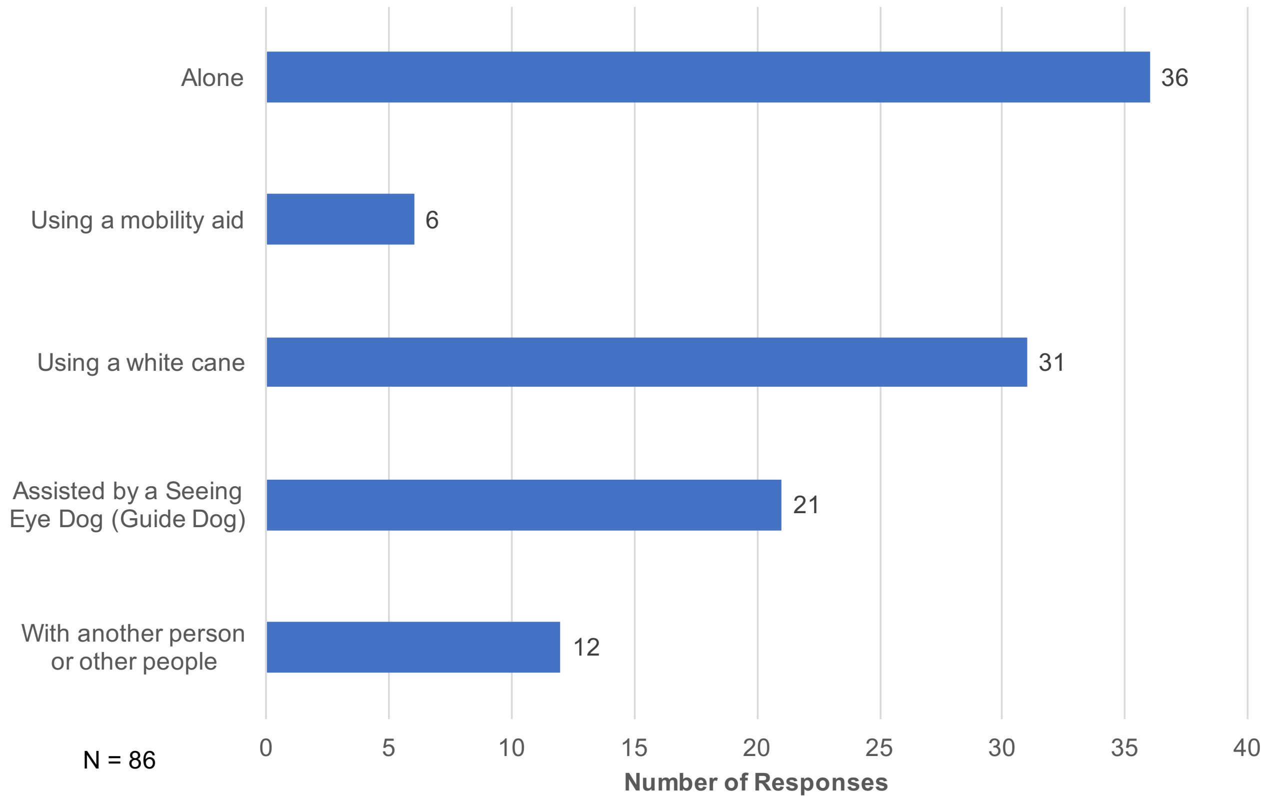


Figure 5.9 Circumstances reported by participants at the time of their collision or near-collision with an electric / hybrid vehicle

Lastly, all participants were asked to reflect on whether the introduction of electric / hybrid vehicles onto Australian roads has reduced their confidence to walk and cross roads. From the total sample, 43(16%) reported that this was the case to a large degree, 76(31%) indicated to some degree, and a further 63(26%) reported to a slight degree. In contrast, 63(26%) reported that it had no impact on them at all. There was one respondent who did not respond to this question.

Confidence levels were then explored a little more closely, relative to their level of vision loss, hearing loss and prior experience with a collision or near-collision with an electric / hybrid vehicle. Relative to level of vision loss, 70% of those who have low vision, 82% of those with severe vision loss and 81% with no useable vision or total blindness reported some degree of reduced confidence following the introduction of electric / hybrid vehicles. These results are summarised in Figure 5.10.

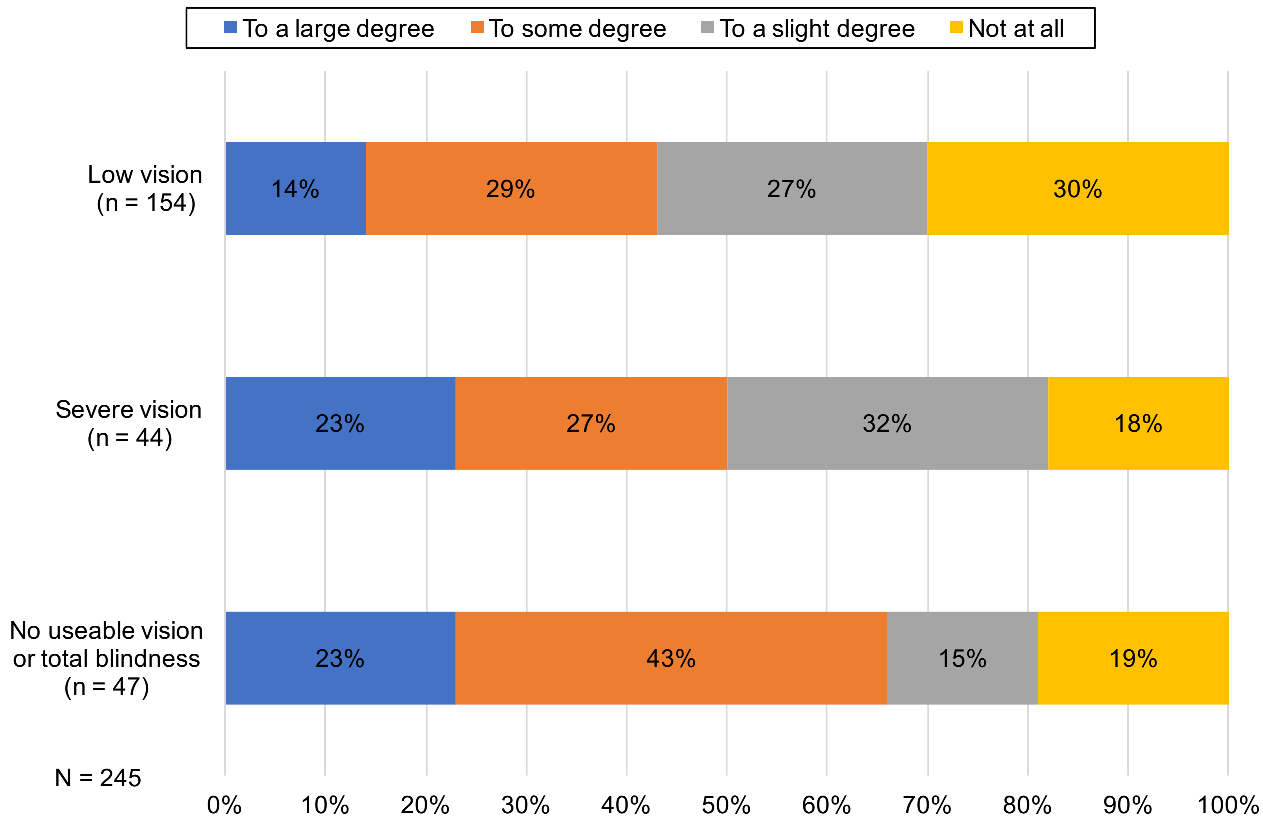


Figure 5.10 Degree of reduced confidence with the introduction of electric / hybrid vehicles relative to level of vision loss

With respect to those who indicated some degree of hearing loss, 45(68%) reported some level of reduced confidence, with the majority of those indicating either some or slight degree of reduced confidence to walk with the introduction of electric / hybrid vehicles.

Lastly, when reduced confidence was examined relative to previous collision or near-collision experiences, of the total respondents to this question (N=237, data was missing for 9 respondents), 83% of those who had experienced at least one collision, 92% of those who had experienced at least one near-collision, in addition to 100% of those who had experienced at least one collision or one near-collision, reported that they felt some level of reduced confidence with the introduction of electric / hybrid vehicles. This is in contrast to only 63% of those who had no experience with collisions or near-collisions reporting having some degree of reduced confidence. Figure 5.11 illustrates these findings. These results suggest that prior adverse experiences with electric / hybrid vehicles are likely to impact on future confidence in travelling on the road network.

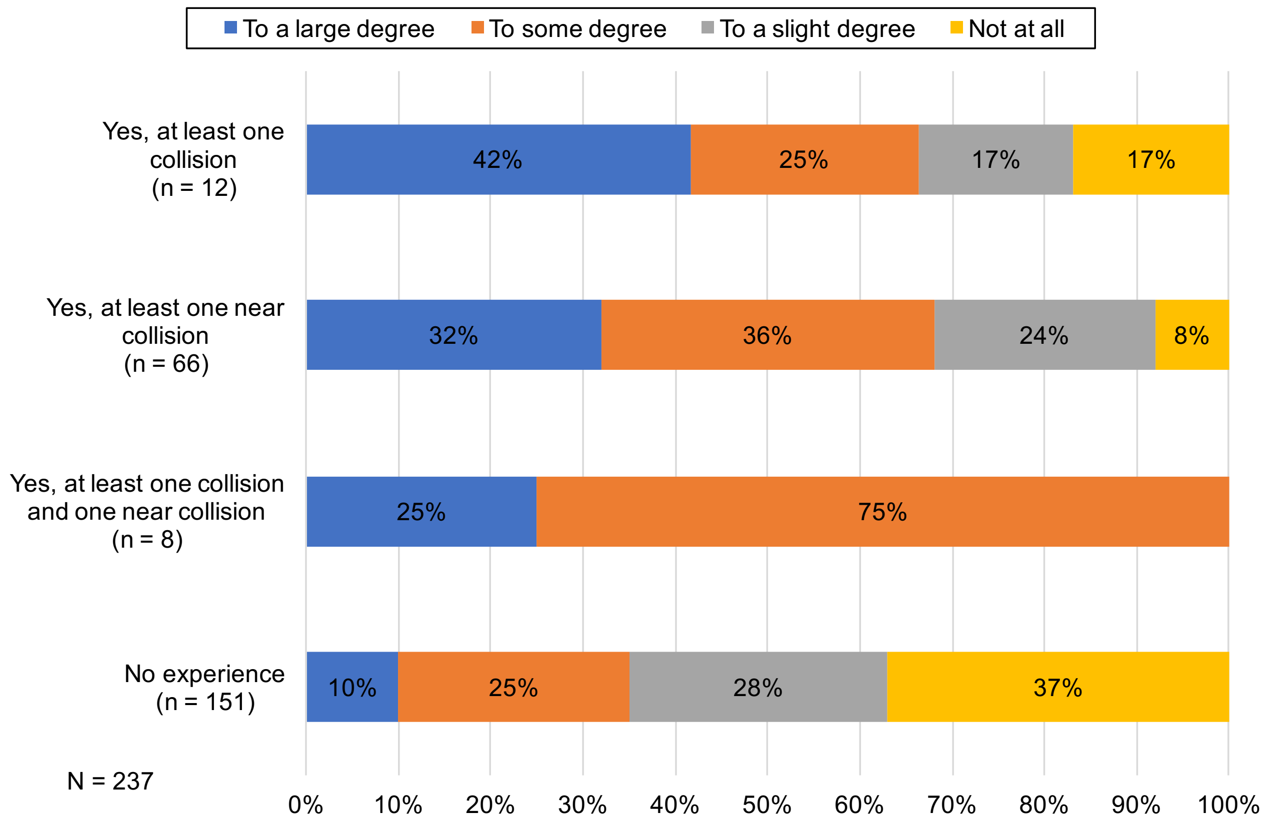


Figure 5.11 Degree of reduced confidence with the introduction of electric / hybrid vehicles relative to previous collision or near-collision experiences with them

5.4.2 BICYCLES AND CYCLISTS

In addition to electric / hybrid vehicles, bicycles and cyclists also pose potential safety risks for pedestrians who are blind or have low vision if they are unable to detect them when they are close by. All respondents were first asked whether they had ever had a collision or near-collision with a cyclist of which 192(78%) participants reported yes. Of these, 37(19%) reported at least one collision, 125(65%) reported at least one near-collision, and a further 30(16%) indicated that they had experienced at least one collision and one near-collision with a cyclist. Figure 5.12 details participants' experiences with collisions or near-collisions with cyclists relative to their level of vision loss. When also considering hearing loss, of those who reported hearing loss 50(76%) respondents indicated that they had at some point experienced at least one collision, near-collision or both with a cyclist.

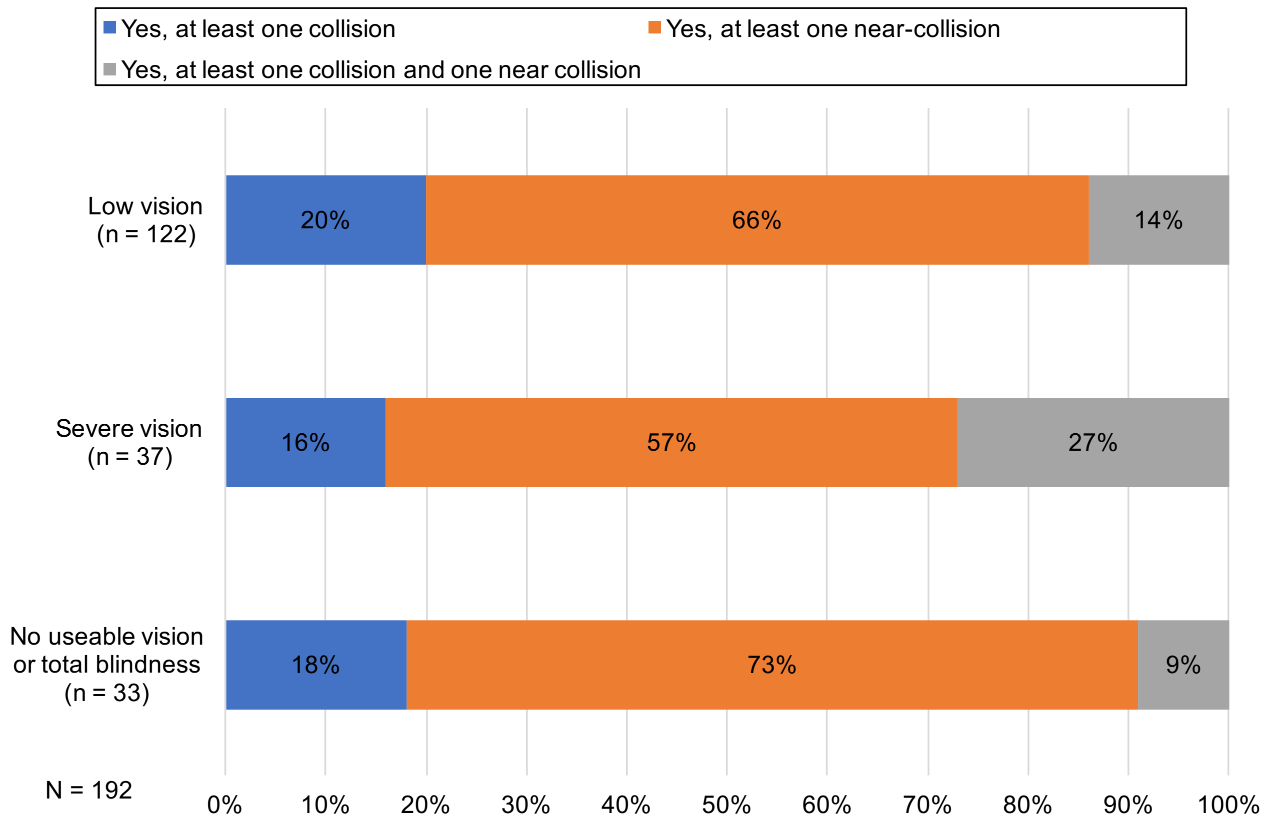


Figure 5.12 Proportion of collisions and near-collisions with cyclists for participants relative to their degree of vision loss

Next data was collected on the recency of participants' collision or near-collision experiences with cyclists. Of those who reported that they had had a collision or near-collision with a cyclist, 58(30%) indicated a collision experience within the last 12 months, whilst 76(40%) reported a near-collision experience within the last 12 months. When participants were asked to rate their confidence that their collision or near-collision experience was with a cyclist, the majority were either extremely confident (171, 89%) or somewhat confident (17, 9%).

Participants were again asked to think about their last collision or near-collision experience with a cyclist, and the location in which this occurred. Of those included, 101(53%) indicated that their experience was in a metropolitan suburban area, a further 52(27%) respondents indicated this occurred in a metropolitan CBD location, and 39(20%) reported a regional or rural country area.

When participants were asked about the walking activity they were engaged in when their collision or near-collision with a cyclist occurred, similar to the responses for electric / hybrid vehicles, the most common response again was walking along on the footpath (33%). This is shown in Figure 5.13. This was closely followed by walking along a shared pedestrian and bicycle pathway (29%), in contrast to electric / hybrid vehicles where crossing roads was more strongly presented and evident.

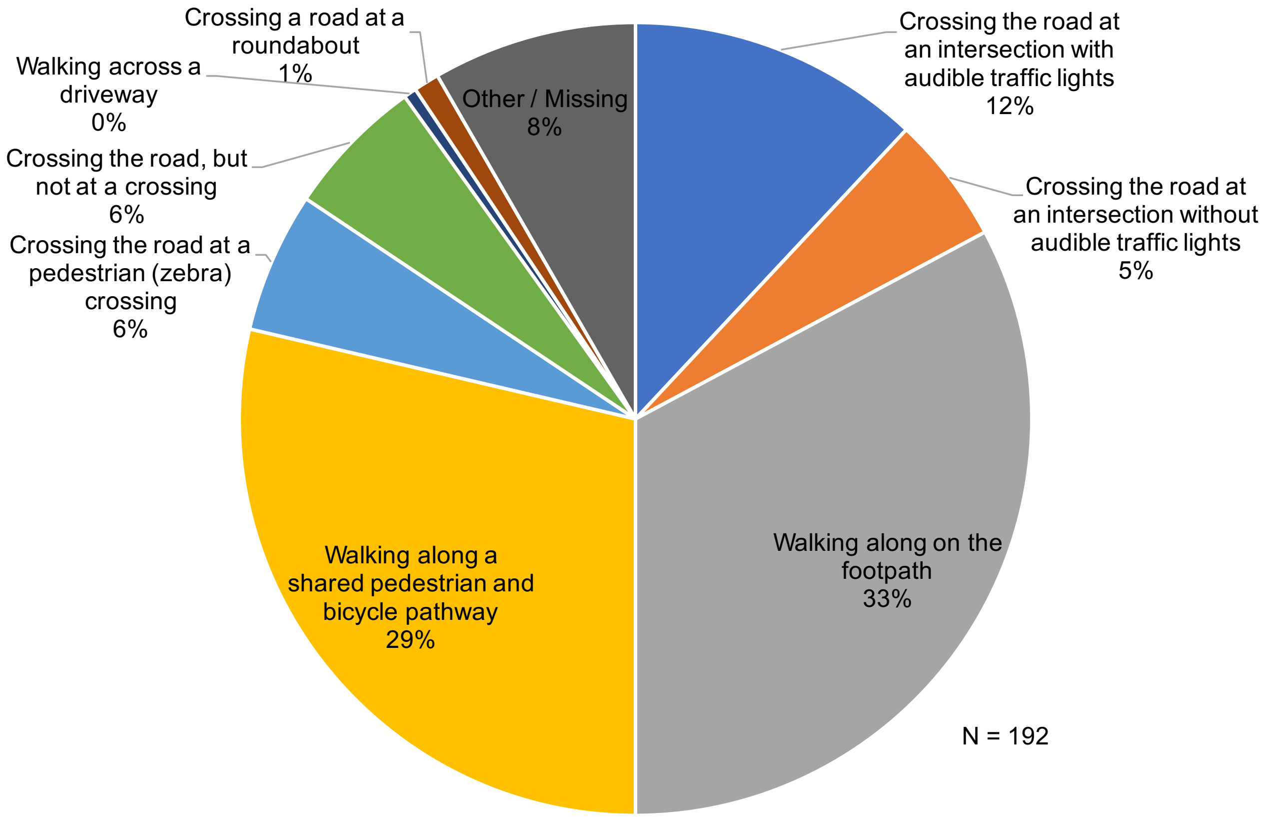


Figure 5.13 Proportion of participants at various walking locations at the time of collision or near-collision with cyclist

Next participants were asked further about their circumstances at the time of collision or near-collision with a cyclist, with respect to whether they were travelling alone, assisted, or with others. Figure 5.14 summarises the responses recorded. Similar to the previous subgroup who had experienced a collision or near-collision with an electric / hybrid vehicle, participants most commonly reported travelling alone. Of those who reported travelling alone (86, 45%) less than five indicated also being accompanied by a Seeing Eye Dog, 20 respondents indicated they were using a white cane, and less than five also reported using a mobility aid. The results again indicate that despite being in the company of others, a Seeing Eye Dog (Guide Dog), or assisted by the use of a mobility aid, participants still reported collisions or near-collisions with cyclists.

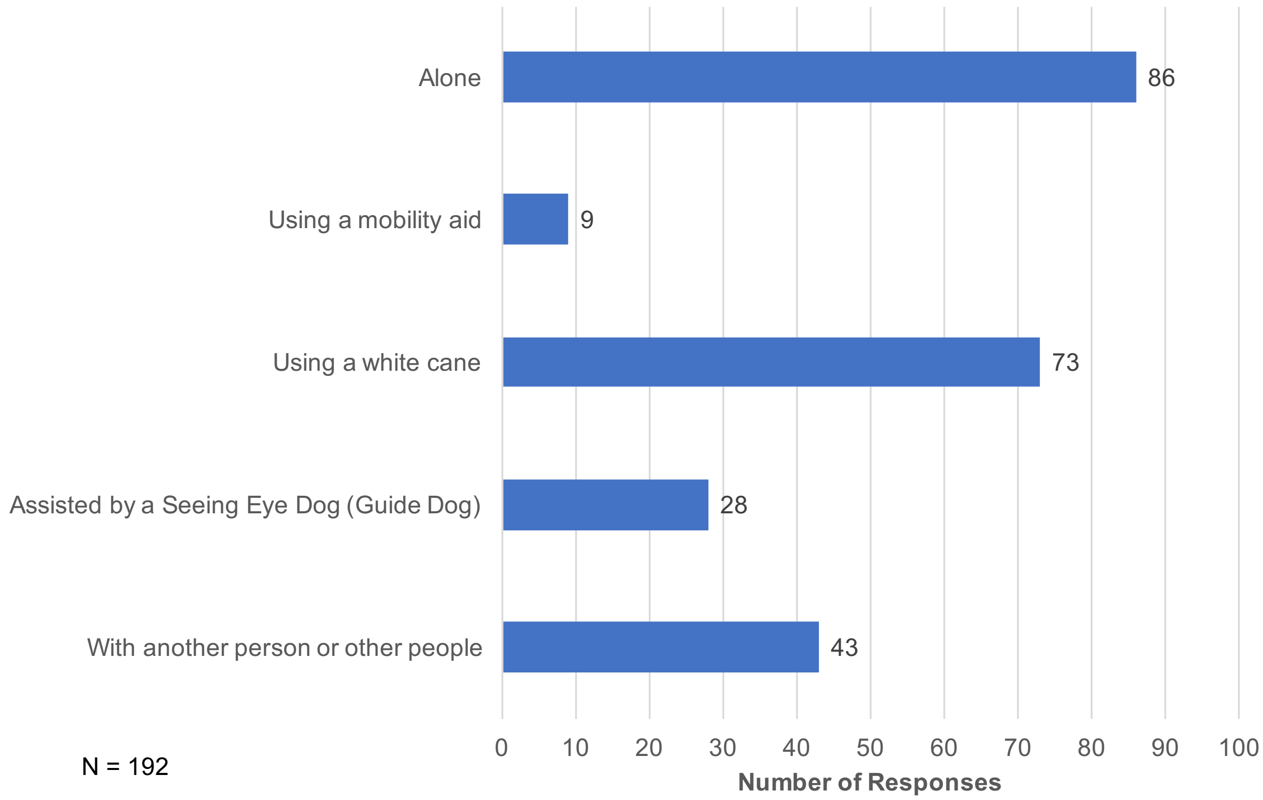


Figure 5.14 Circumstances reported by participants at the time of their collision or near-collision with a cyclist

Lastly, it was again important to assess whether the presence of cyclists specifically affected participants' confidence to travel on the road network. When the total sample was asked to reflect on this, 185(75%) reported at least some degree of reduced confidence, and of these, 46(25%) indicated a reduced confidence to a large degree, 74(40%) reported some degree whilst a further 65(35%) reported a slight degree of reduced confidence.

It was also important to explore whether this differed relative to vision loss, hearing loss and previous collision or near-collision experiences with cyclists. Figure 5.15 illustrates the proportion of individuals who reported different levels of reduced confidence relative to their vision loss. Overall, 77% of participants with low vision, 82% of those with severe vision loss, and an additional 64% of those with no useable vision or total blindness indicated some level of reduced confidence. Noteworthy, the group with the least functional vision revealed the highest proportion of those who reported that their confidence to travel on the road network with cyclists was not at all reduced.

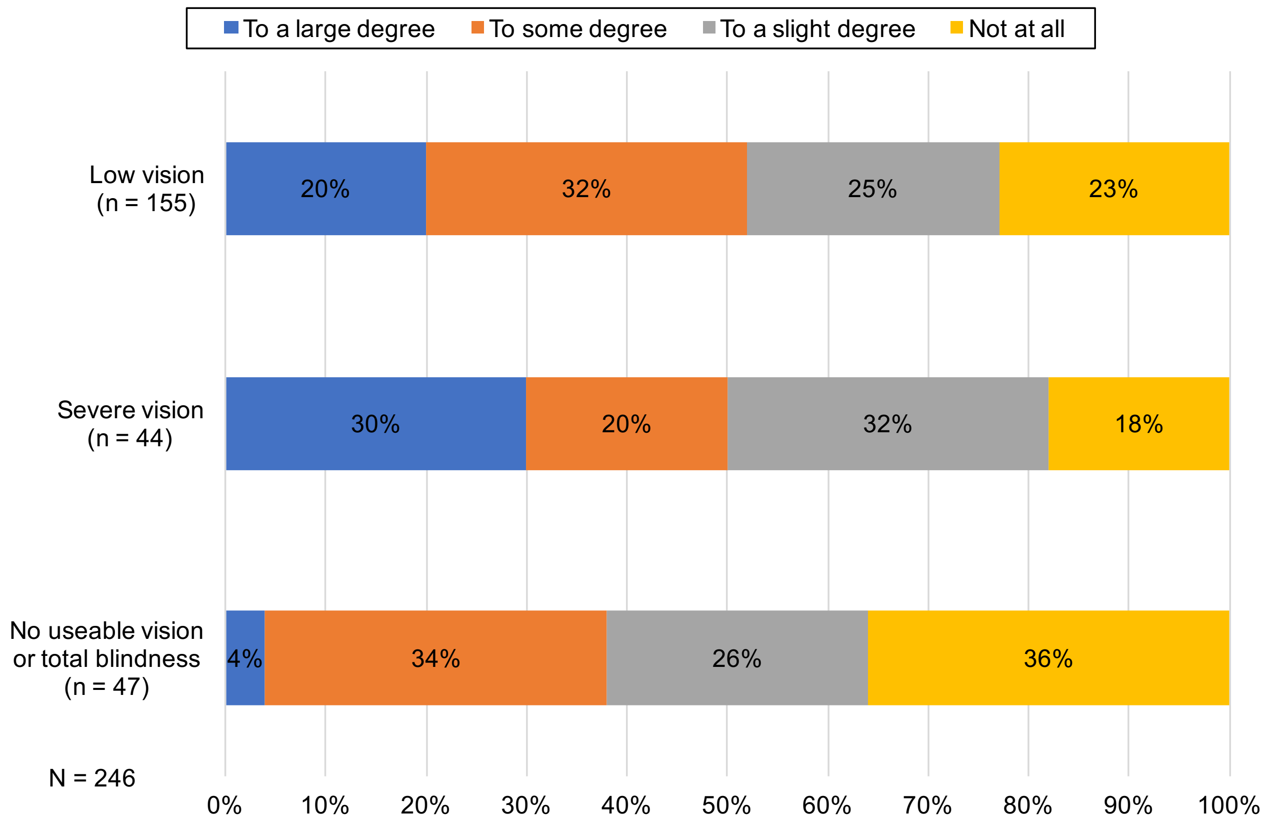


Figure 5.15 Degree of reduced confidence with cyclists on the road network relative to level of vision loss

Confidence was then examined, considering level of hearing loss. Of those who reported some level of hearing loss, 51(77%) indicated some level of reduced confidence with cyclists travelling on the road network. This was higher relative to what was reported for the presence of electric / hybrid vehicles.

Lastly, confidence levels were examined relative to personal experiences with collision or near-collisions with cyclists, as summarised in Figure 5.16. Of those with no previous experience, half of them reported that cyclists on the road network did not at all reduce their confidence to walk and cross roads. However, for those who had experienced at least one collision and one near-collision, 83% reported some level of reduced confidence. Further 81% of those who had experienced a near-collision reported some level of reduced confidence and lastl7 86% of those who had experienced a previous collision with a cyclist reported some degree of reduced confidence. It is evident from both these results, and those with respect to electric / hybrid vehicles that personal collision or near-collision experiences are likely to impact on overall confidence to continue walking and crossing roads.

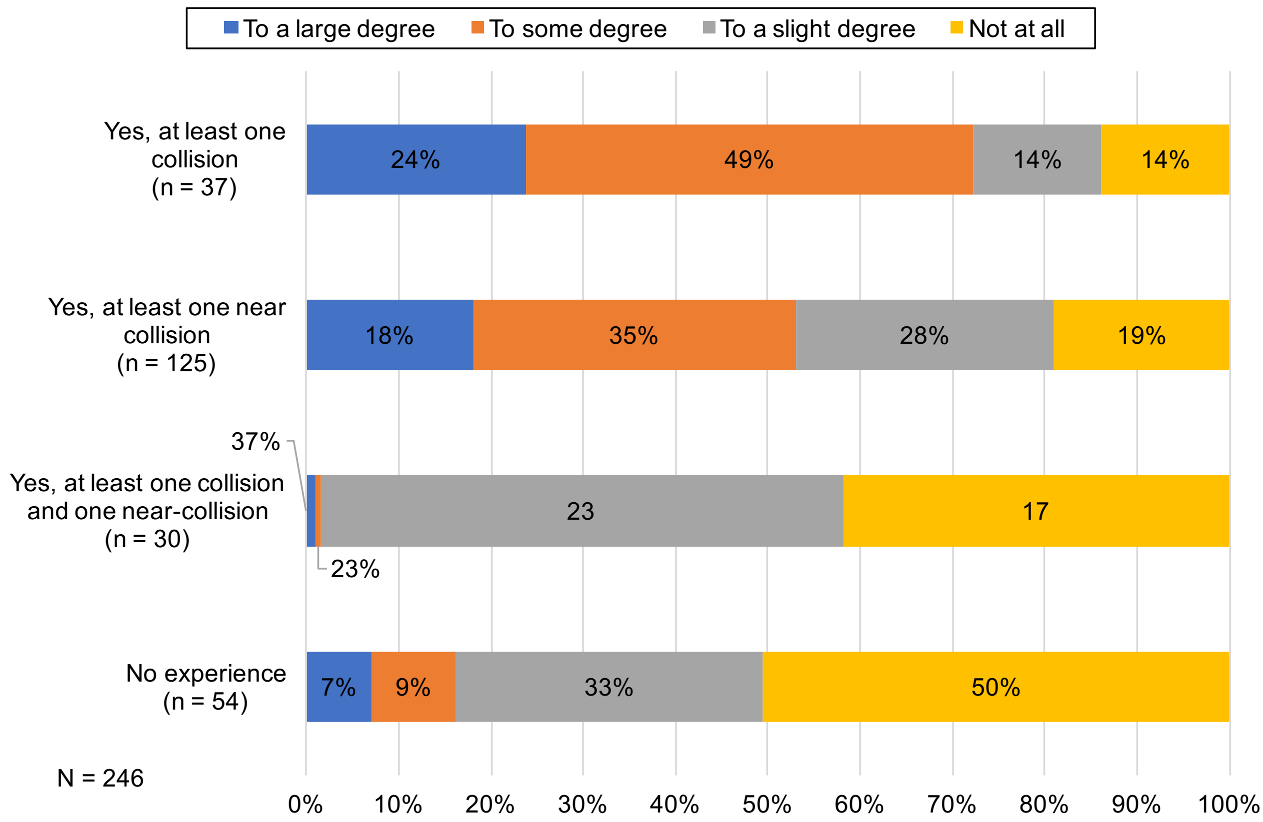


Figure 5.16 Degree of reduced confidence cyclists on the road network relative to previous collision or near-collision experiences with them

5.4.3 CANE REPLACEMENT

One theme that arose during the focus groups which were used to assist development of the survey was the fact that canes were often required to be replaced due to collisions or near-collisions. Participants were asked to report on how often their cane or white cane tip had to be replaced within the last 12 months due to contact with a vehicle or bicycle. Of the total sample that responded and reported that they own or use a cane (193, 78%), the majority (150, 78%) reported that they had not had to replace any part of their cane within the last 12 months. However, 34(18%) respondents indicated that they have had to replace a part of their cane at least once or twice, with a further 9(5%) reporting three, four or five or more times.

5.5 HEALTH AND WELL-BEING

5.5.1 IMPACT OF COLLISION OR NEAR-COLLISION EXPERIENCES

As highlighted in the previous section, a significant proportion of the sample reported having experienced a collision and / or a near-collision. It is likely that these experiences may have impacted on their ability and confidence to travel independently outside of their home. This can have significant overall health and well-being consequences. Given the importance of this consideration, the survey also asked participants whether their experiences with collisions or near-collisions had impacted on their travel patterns. Just under half (97, 40%) of those who responded indicated yes. In contrast, just under half (117, 48%) reported that it had not impacted on their travel patterns. The remaining portion of the sample indicated that they were unsure or preferred not to say.

Of interest was also whether participants continued to travel outside of their house following experiences with collisions or near-collisions. Of the total sample who responded, 157(64%) reported that their experiences have had no impact on how much they go out. A further 83(34%) indicated that their collision or near-collision experiences had reduced the amount in which they go out to an extent; 41 indicated slightly, 26 indicated somewhat and 16 reported it had significantly reduced the amount in which they go out. Based on these findings, it is evident that collision or near-collision experiences impact on pedestrians who are blind or have low vision, and their choice or confidence to continuing leaving the house and walk.

5.5.2 PHYSICAL AND MENTAL HEALTH

Participants were asked some questions related to their overall health, as well as more specifically their physical and mental health. Of the total sample, 47(19%) report excellent health, 130(53%) reported good health, 59(24%) indicated fair health, and a further 10(4%) reported poor health. It appears that the majority of the sample self-report that their health is well.

Of interest was to look a little more closely at their physical and mental health. Participants were asked whether they were currently suffering from any physical conditions, or diagnosed mental health conditions. Figure 5.17 summarises the responses. Of the total sample, 42% indicated that they had at least one physical condition, whilst a third of the participants also indicated that they had at least one diagnosed mental health condition.

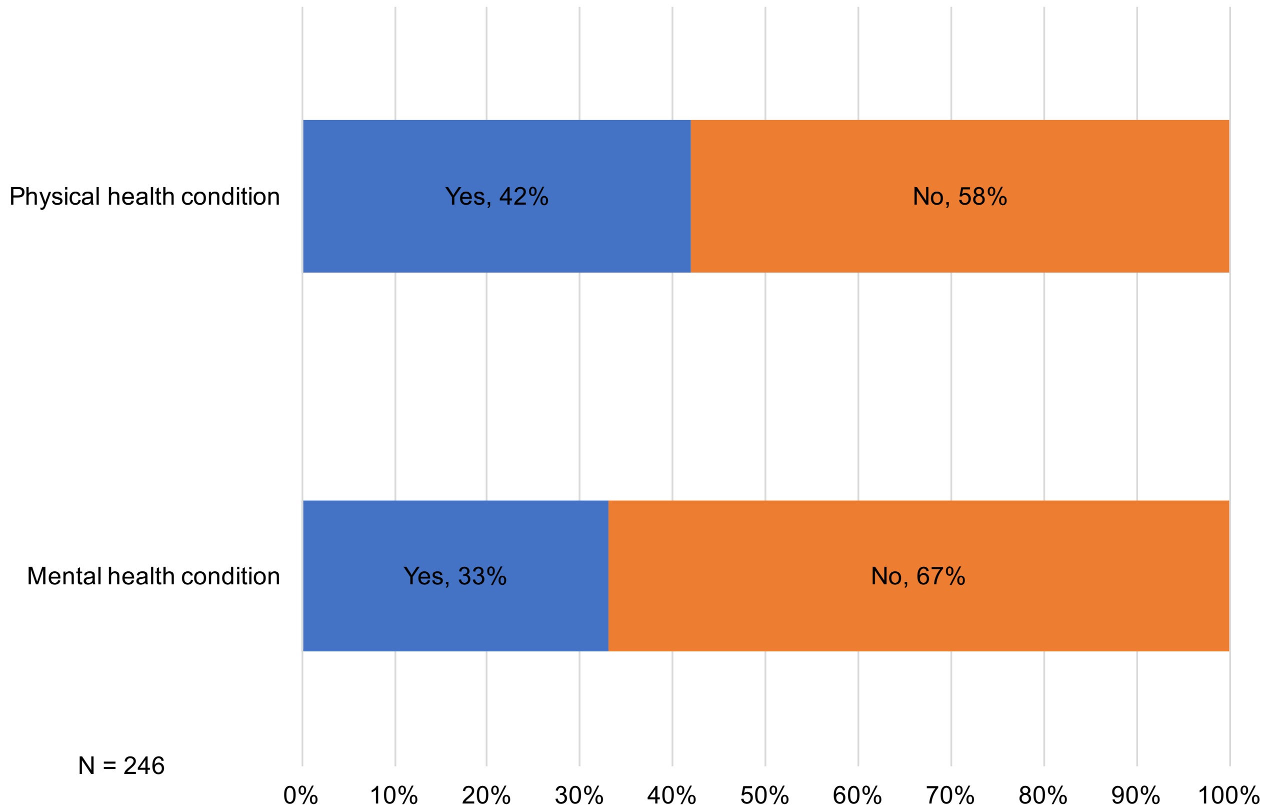


Figure 5.17 Self-report physical and mental health conditions reported by participants

Further, participants were also asked about any depression or anxiety like symptoms they may currently have related to walking and crossing roads. Figure 5.18 summarises the responses from the participant sample. Just over half reported some degree of sadness related to how they feel about walking or crossing roads. Whist 28% indicated slight sadness and 16% reported some sadness, 10% of all respondents indicated depression related symptoms when thinking about walking or crossing roads. With respect to anxiety, the majority of respondents (87%) reported some level of worry about walking and crossing roads. Whilst the majority reported slight or some worry, 16% of the total sample indicated extreme anxiety symptoms related to walking. These findings suggest that a significant level of distress is experienced by a proportion of individuals, which highlights the important need to enhance the safety experience for pedestrians who are blind or have low vision.

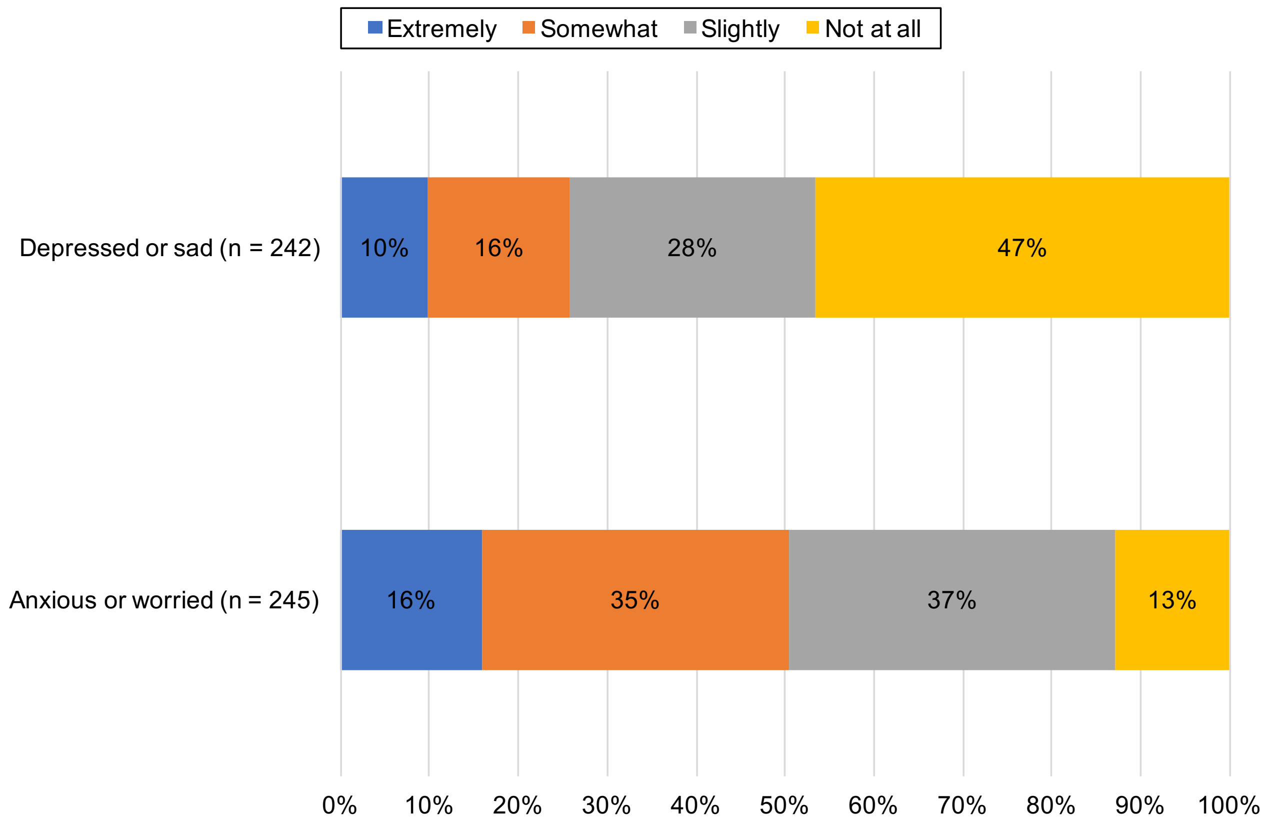


Figure 5.18 Self-reported current levels of sadness or worry related to walking or crossing roads

5.6 COUNTERMEASURES

As highlight in the previous section, there is an important need to identify effective countermeasures to ensure that pedestrians who are blind or have low vision can feel comfortable and safe walking on the road network amongst other road users. The presence of different road users travelling together on the road network system results in those that are most vulnerable being at increased safety risk. As part of this study, it was important to explore potential countermeasures to enhance safety for pedestrians who are blind or have low vision, but also pedestrians more broadly. In order to identify potentially effective countermeasures, participants were asked to rate their level of support for five selected countermeasures: reducing vehicle speeds, increasing the noise threshold for electric / hybrid vehicles, increasing orientation and mobility training (specifically related to navigating electric / hybrid vehicles and cyclists), increasing community awareness (about the impact of electric / hybrid vehicles or cyclists on pedestrians who are blind or have low vision), in addition to the provision of counselling services to support those who experience distress related to walking on the roads. Figure 5.19 summarises the level of support across each countermeasure.

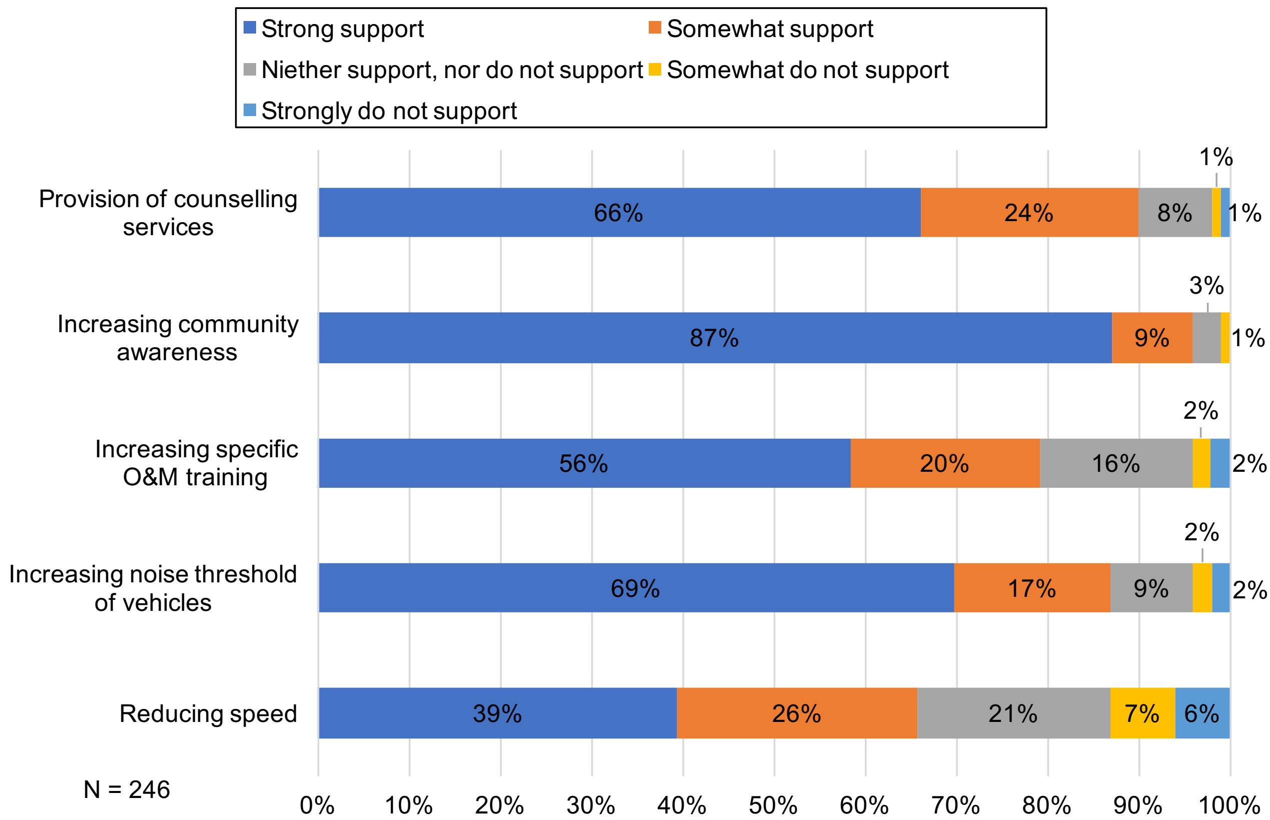


Figure 5.19 Level of support for countermeasures to enhance safety for pedestrians

Based on the responses indicated, it appears that participants within the sample most strongly support the idea of raising community awareness regarding the safety impact of electric / hybrid vehicles and cyclists on pedestrians who are blind or have low vision. Further, there is also significant support for both increasing the noise threshold of vehicles as well as the provision of counselling services to support those who experience distress related to walking outside. Interestingly, the lowest supported countermeasure was the reduction of speed.

6.0 SUMMARY AND CONCLUSIONS

This research aimed to assess the impact of electric / hybrid vehicles, and bicycles on the travel experiences of pedestrians who are blind or have low vision. A literature review focused on electric / hybrid vehicles was initially conducted. This was followed by two focus group workshops and an online community-based survey, both designed to develop a better understanding of road safety concerns for this pedestrian subgroup.

The overarching result from this research has identified that the introduction and gradual increase in electric / hybrid vehicles on Australian roads poses a significant safety concern for pedestrians who are blind or have low vision. A large proportion of participants in both the focus groups and the survey indicated having ever experienced either collisions, or near-collisions with electric / hybrid vehicles. The main issue raised is the difficulty in detecting these quiet vehicles, without the full use of their sight being available. Whilst a minimal noise threshold regulation for these vehicles has been passed in other countries throughout the world, Australia has yet to adopt any regulation standards to date.

In addition to electric / hybrid vehicles, pedestrians who are blind or have low vision also encounter safety issues when utilising shared pathways with cyclists. Again, a significant proportion of participants in both the workshops and the community-based survey reported collisions or near-collisions with cyclists. Whilst the injury severity may not be as severe as those incidents with larger vehicles, such as electric / hybrid vehicles, such adverse safety experiences have a significant impact on the overall mobility, travel patterns and general well-being of pedestrians who are blind or have low vision. This is consolidated by the finding that a number of these individuals report reduced walking, in addition to symptoms consistent with depression and anxiety.

As part of the World Health Organisations Sustainable Development Goals (SDGs), SDG 3 – *Good health and well-being for people* and SDG 11 – *Sustainable cities and communities* are both relevant to the present research. These goals capture the importance of inclusiveness and the right for all individuals to feel safe in their community. People with disabilities can be disadvantaged in the community, and in a car-centric country such as Australia, pedestrians who are blind or have low vision are particularly vulnerable on the road network.

However, there are a range of countermeasure that can be adopted to mitigate this disadvantage and ensure that the well-being of all road user groups is taken into consideration. They include a range of vehicle-based, infrastructure-based, road-user-based and more broadly, community-based interventions to mitigate the increased safety risk for pedestrians who are blind or have low vision. It is also important to note that the safety benefits achieved for pedestrians who are blind or have low vision are likely to have generalisable effects on the broader pedestrian community including children and elderly pedestrians. Moving forward, increasing community awareness and understanding surrounding this issue will play a significant role in reducing pedestrian-related trauma.

Prior to concluding, it is important to acknowledge the limitations of the study. In particular, the small sample size, potential bias associated with online recruitment, and self-report are important to note when interpreting the findings. In contrast, the study recruited an Australian-wide sample which is a strength. Future research would benefit from including a comparison pedestrian sample to quantify the risk for pedestrians who are blind or have low vision, relative to the broader pedestrian population.

In summary, the findings from this research relative to the previous study conducted on road safety of pedestrians who are blind or have low vision (Oxley et al., 2012a) have identified that collisions and near-collisions remain a significant risk for this subpopulation. With the upcoming increase in electric / hybrid vehicles in Australia, this risk is likely to increase unless measures are taken to protect vulnerable road users. Therefore, a series of recommendations have been proposed to support increased safety for pedestrians who are blind or have low vision.

7.0 RECOMMENDATIONS

7.1 VEHICLE-BASED RECOMMENDATIONS

- Given Australia's stated preference to harmonise vehicle safety standards with Europe, immediately adopt UN Regulation No 138-01 on the approval of *Quiet Road Transportation Vehicles* (QRTV) to ensure fitment of an *Acoustic Vehicle Alerting System (AVAS)* on all hybrid and electric vehicles.
- Promote the Regulation and accelerated uptake of advanced driver assistance systems (ADAS), including Auto Emergency Braking (AEB), Collision Evade Assist, and collision-warning systems using radar, lidar and DSRC-based detection systems.
- Explore the use of vehicle-to-pedestrian warning based systems, including DSRC technologies, which provide early warning of vulnerable pedestrians to vehicle drivers.

7.2 INFRASTRUCTURE-BASED RECOMMENDATIONS

- Provide extended pedestrian crossing times at signalised intersections, and ensure all signalised intersections include audio-tactile pedestrian push button assemblies.
- Provide for controlled pedestrian crossings in high pedestrian areas, and those with high density for pedestrians who are blind or have low vision.
- Provide directional and warning Tactile Ground Surface Indicators (TGSIs) to assist pedestrians who are blind and have low vision in crossing the road safely.
- Road authorities to consider safety improvements such as raised platforms and lower speeds at roundabouts and turn slip-lanes, as these present unique difficulties for pedestrians who are blind or have low vision.
- Road authorities ensure alignment of path landings to ensure ease of crossing roads in a straight-line insofar as possible.
- Promote the retrofitting of road infrastructure features outlined in *Accessibility Guidelines* in locations found not to comply (see for example, VicRoads Traffic Engineering Manual, Volume 3 – Additional Network Standards and Guidelines: Accessibility (DDA) Guidelines, 2017).

7.3 ROAD-USER BEHAVIOUR RECOMMENDATIONS

- Conduct an activity mapping study of a sample of people who are blind or have low vision using wearable technologies to identify common travel patterns and locations, in order to identify safety improvements.
- Conduct a large-scale education program across multiple channels (i.e., print, radio, social media) highlighting the need for vehicle drivers to demonstrate safe road use behaviours when interacting with pedestrians.

- Introduce a practical component into Orientation and Mobility training to assist people who are blind or have low vision to recognise the unique sounds of electric and hybrid vehicles.

7.4 BROADER COMMUNITY-BASED RECOMMENDATIONS

- Increase community awareness via education of the safety risks experienced by pedestrians who are blind or have low vision. It is important to highlight the road user needs of pedestrians who are blind or have low vision.
- Develop psychological support-based networks for people who are blind or have low vision as part of continuing to promote active living and mobility.

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APPENDIX A

UN Regulation No. 138-01 (UN 2017): Uniform provisions concerning the approval of Quiet Road Transport Vehicles with regard to their reduced audibility

Adopted on the 14 September 2017, UN Regulation No. 138 (Revision 1) outlines requirements for the emission of sound when Quiet Road Transport Vehicles (QRTV) travel at low speed. This is to address concerns regarding the lower audible signals from these vehicles. UN Regulation No. 138 in its original form was passed on the 4th March 2016 (UN, 2016).

Scope

Per the *Regulation (Rev.1),* the requirements apply 'to electrified vehicles of categories passenger vehicles (Category M) and goods vehicles (Category N, light commercial vehicles, trucks) which can be propelled in the normal mode, in reverse or at least one forward drive gear, without an internal combustion engine operating (ICE) in respect to their audibility' (s.1).

For the purpose of the *Regulation,* electrified vehicles are those with 'at least one electric motor of electric motor generator' (S.2), and includes Pure Electric Vehicles (PEV), Hybrid Electric Vehicles (HEV), Fuel Cell Vehicles (FCV), and Fuel Cell Hybrid Vehicles (FCHV).

Requirement: Emission of sound

UN Regulation No.138 requires that electrified passenger and goods vehicles emit as sound when travelling up to 20 km/h. In the *Regulation*, this is known as an *Acoustic Vehicle Alerting System (AVAS)*

Sound (AVAS) requirements

The AVAS has the following requirements:

Operates vehicle the vehicle is travelling greater than 0 km/h up to and inclusive 20 km/h.

Includes forward and reversing travel, with different test specifications and requirements.

Forward test speeds are 10 km/h and 20 km/h, with different db(A) requirements, with minimum noise requirements given frequency of the tone. There is a requirement to vary the sound so that changes in vehicle speed (i.e., acceleration, deceleration) can be detected. Requirements also capture tone frequency, specified as 1/3 octave bands.

Forward travel: maximum sound is 75 dB(A) measured at 2 metres (to control noise pollution), which is equivalent to 66 dB(A) measured at a distance of 7.5 m (i.e., the minimum sound level). The minimum sound is 50 db(A) for 10 km/h and 56 db(A) for 20 km/h.

For reversing vehicles, the minimum sound requirement is 47 db(A).

Sounds can also be emitted when the vehicle is stationary (optional), while no pause function is allowed (Revision 1, Reg. 138). It is important to note that in the original version of UN Reg. 138, the pause function was permitted but has since been amended and removed following concern by the World Blind Union (WBU) and a number of contracting parties (country signatories).

Manufacturers can elect one or more tones, selectable by the driver so long as each meets the test requirements.

Date of force

While UN Regulation 138 was in force on the 5th October 2016, and UN Regulation 138 (Revision 1) from 10 October 2017, fitment of AVAS onto vehicles occurs from September 2019 for new vehicle types and September 2021 for all electric vehicles in Europe. *There is currently no requirement in Australia for vehicles to meet this Regulation.*

APPENDIX B

THE IMPACT OF ELECTRIC / HYBRID VEHICLES AND BICYCLES ON PEDESTRIANS WHO ARE BLIND OR HAVE LOW VISION

You are invited to take part in this survey designed to explore the safe mobility of adult pedestrians who are blind or have low vision. We are particularly interested in your travel history, and in particular your experiences with electric / hybrid vehicles and bicycles.

This research is being conducted by the Monash University Accident Research Centre (MUARC) and is supported by Vision Australia. The information you provide will remain confidential, and not be used to identify you as an individual. The survey will take approximately 15-20 minutes to complete. For some further information on participating, please read through the **Explanatory Statement** before you continue.

If you would like assistance to complete the survey from a representative at Vision Australia, please call: INSERT PHONE NUMBER

To begin the survey please click on the link below:

START SURVEY

SECTION A: VISION AND HEARING LOSS

A.1 Do you have a degree of vision loss that cannot be corrected by glasses or contact lenses?

☐ Yes

☐ No *Skip to End of Survey*

A.2 Which of the below defines your level of vision or otherwise?

☐ Low vision (i.e., unable to drive a car, great difficulty reading print material, difficulty recognising people).

☐ Severe low vision (i.e., you are not able to use printed material at all and have a strong preference for information in audible or brailed format).

☐ No usable vision.

☐ Total blindness (i.e., you have no light perception).

A.3 Please describe which condition(s) affects your vision?

____

____

A.4 How old were you when you first began to experience vision loss?

____

____

A.5 Do you have a degree of hearing loss that is not corrected by a hearing aid?

☐ Yes

☐ No *Skip to B.1*

A.6 Would you say your hearing loss is…

- ☐ Slight
- ☐ Mild
- ☐ Moderate
- ☐ Severe
- ☐ Profound
- ☐ Totally deaf

A.7 Please describe which condition(s) affects your hearing?

____

____

A.8 How old were you when you first began to experience hearing loss?

____

____

SECTION B: TRAVEL INFORMATION

B.1 How many days per week do you typically walk outside your home?

- ☐ Daily or almost daily
- ☐ 3-4 days a week
- ☐ Once or twice a week
- ☐ A few times a month
- ☐ Once a month or less
- ☐ Never *Skip to B.6*

B.2. When you walk outside your home, which statement best describes you?

- ☐ I mostly walk outside unassisted by another person, mobility aid (such as a white cane) or Seeing Eye Dog (Guide Dog).
- ☐ I sometimes walk outside unassisted by another person, mobility aid (such as a white cane) or Seeing Eye Dog (Guide Dog).
- ☐ I rarely walk outside unassisted by another person, mobility aid (such as a white cane) or Seeing Eye Dog (Guide Dog).
- ☐ I never walk outside unassisted by another person, mobility aid (such as a white cane) or Seeing Eye Dog (Guide Dog).

B.3 When you do walk outside assisted, which statement best describes you?

- ☐ When walking outside assisted, I mostly use a mobility aid (such as a white cane).
- ☐ When walking outside assisted, I mostly use a Seeing Eye Dog (Guide Dog).
- ☐ When walking outside assisted, I sometimes use a mobility aid (such as a white cane) and I also sometimes use a Seeing Eye Dog (Guide Dog).
- ☐ I never walk outside assisted.

B.4 How far do you normally walk each week?

- ☐ Less than 2km
- ☐ 2-5km
- ☐ 5-10km
- ☐ 10km or more
- ☐ I am not sure

B.5 In a typical week, what are the main reasons you walk? You can select more than one response.

- ☐ To run errands (e.g., post office / bank / shops)
- ☐ Work
- ☐ Education or training
- ☐ Medical / health appointments
- ☐ Sports / social club
- ☐ Church or place of worship
- ☐ Visit family / friends
- ☐ Recreation / fitness
- ☐ To access and use public transport
- ☐ Other (please specify):

____

B.6 Compared to 5 years ago, would you say you are…

- ☐ Walking more
- ☐ Walking less
- ☐ Walking about the same amount *Skip to C.1*
- ☐ I am not sure *Skip to C.1*

B.6 If your amount of walking has changed, why do you think it has changed?

____

____

SECTION C: WALKING AND MOBILE PHONE USE

C.1 How often do you use your mobile phone when walking?

- ☐ Never
- ☐ Sometimes
- ☐ Regularly
- ☐ Almost all the time

C.2 When using your mobile phone while walking, do you mostly…?

- ☐ Read the screen with your eyes.
- ☐ Listen to the phone's audio output using the speaker on the phone.
- ☐ Use ear phones or headphones to hear the audio output of the phone.

C.3 How often do you use Apps on your smart phone to support navigation?

- ☐ Never
- ☐ Sometimes
- ☐ Regularly
- ☐ Almost all the time

C.4 When crossing a road, do you…?

- ☐ Always put your phone away and remove your earphones / headphones before crossing.
- ☐ Sometimes put your phone away and remove your earphones / headphone before crossing.
- ☐ Rarely put your phone away and remove your earphones / headphones before crossing.
- ☐ Never put your phone away or remove your earphones / headphones before crossing.

C.5 Do you feel your mobile phone use whilst walking…?

- ☐ Has no impact on your ability to remain safe.
- ☐ Has some impact on your ability to remain safe but you can manage any safety concerns using various techniques to avoid incidents.
- ☐ Has a high impact on your ability to remain safe, so much so that you are often distracted using your mobile phone and would be better off not using it whilst walking.

SECTION D: COLLISION AND NEAR-COLLISION INVOLVEMENT

This next section will ask you some questions about your past experiences with near-collisions and / or collisions. We understand that these questions may bring back some memories that might be distressing. If you feel uncomfortable, or do not wish to answer any of the following questions, you have the option of skipping through them. Support services are also provided in the Explanatory Statement if you wish to contact them.

D.1 Thinking back over the last 5 years, have you been involved in a collision or near-collision with a vehicle or cyclist?

- ☐ Yes, at least one collision *Please answer D.2 and skip D.3*
- ☐ Yes, at least one near-collision *Please skip D.2 and answer D.3*
- ☐ Yes, at least one collision and one near-collision *Please answer D.2 and D.3*
- ☐ No *Skip to E.1*

D.2 How many times have you experienced a collision with a vehicle or bicycle in the last 5 years?

- ☐ Once
- ☐ Twice
- ☐ Three times
- ☐ Four times
- ☐ Five or more times

D.3 How many times have you experienced a near-collision with a vehicle or bicycle in the last 5 years?

- ☐ Once
- ☐ Twice
- ☐ Three times
- ☐ Four times
- ☐ Five or more times

D.4 Have you ever had a collision or near-collision with an electric / hybrid vehicle?

- ☐ Yes, at least one collision
- ☐ Yes, at least one near-collision
- ☐ Yes, at least one collision and one near-collision
- ☐ No *Skip to D.10*

D.5 Was the most recent collision or near-collision with an electric / hybrid vehicle within the last 12 months?

- ☐ Yes
- ☐ No
- ☐ I can't recall

D.6 Thinking about the last collision or near-collision you had with an electric / hybrid vehicle, how confident are you that it was an electric / hybrid vehicle?

- ☐ Extremely confident
- ☐ Somewhat confident
- ☐ Not confident at all

D.7 Was this collision or near-collision in a metropolitan, regional or rural area?

- ☐ Metropolitan, CBD
- ☐ Metropolitan, Suburbs
- ☐ Regional Areas (e.g., Geelong, Newcastle, Gold Coast)
- ☐ Rural Country
- ☐ Other (please specify):

D.8 At the time of the collision or near-collision, were you…?

- ☐ Crossing the road at an intersection with audible traffic lights.
- ☐ Crossing the road at an intersection without audible traffic lights.
- ☐ Walking along on the footpath.

D.9 At the time of the collision or near-collision, were you…?

- ☐ With another person or other people
- ☐ Assisted by a Seeing Eye Dog or Guide Dog
- ☐ Using a white cane
- ☐ Using a mobility aid
- ☐ By yourself
- ☐ I don't recall

D.10 Please describe the strategies you use to detect electric / hybrid vehicles when crossing roads.

D.11 Has the introduction of electric / hybrid vehicles reduced your confidence to walk and cross roads?

- ☐ To a large degree
- ☐ To some degree
- ☐ To a slight degree
- ☐ Not at all

D.12 Have you ever had a collision or near-collision with a cyclist?

- ☐ Yes, at least one collision
- ☐ Yes, at least one near-collision
- ☐ Yes, at least one collision and one near-collision
- ☐ No *Skip to D.18*

D.13 Was the most recent collision or near-collision with a cyclist in the last 12 months?

- ☐ Yes
- ☐ No
- ☐ I can't recall

D.14 Thinking about the last collision or near-collision you had with a cyclist, how confident are you that it was a cyclist?

- ☐ Extremely confident
- ☐ Somewhat confident
- ☐ Not confident at all

D.15 Was this collision or near-collision in a metropolitan, regional or rural area?

- ☐ Metropolitan, CBD
- ☐ Metropolitan, Suburbs
- ☐ Regional Areas (e.g., Geelong, Newcastle, Gold Coast)
- ☐ Rural Country
- ☐ Other (please specify):

____

____

D.16 At the time of the collision or near-collision, were you…?

- ☐ Crossing the road at an intersection with audible traffic lights.
- ☐ Crossing the road at an intersection without audible traffic lights.
- ☐ Walking along on the footpath.

D.17 At the time of the collision or near-collision, were you…?

- ☐ With another person or other people
- ☐ Assisted by a Seeing Eye Dog or Guide Dog
- ☐ Using a white cane
- ☐ Using a mobility aid
- ☐ By yourself
- ☐ I don't recall

D.18 Please describe the strategies you use to detect cyclists when crossing roads.

____

____

D.19 Does the presence of cyclists on the road reduce your confidence to walk and cross roads?

- ☐ To a large degree
- ☐ To some degree
- ☐ To a slight degree

Not at all

D.20 Has your experience with collision(s) or near-collision(s) affected your walking / travel patterns?

- ☐ Yes
- ☐ No
- ☐ I am unsure

D.19 Has your experience with collision(s) or near-collision(s) impacted on the amount that you leave the house?

- ☐ It has significantly reduced the amount that I go out.
- ☐ It has somewhat reduced the amount that I go out.
- ☐ It has slightly reduced the amount that I go out.
- ☐ It has had no impact on how much I go out.

D.20 At present, how anxious or worried do you feel about walking and crossing roads?

- ☐ Extremely anxious
- ☐ Somewhat anxious
- ☐ Slightly anxious
- ☐ Not anxious at all.

D.21 At present, how sad or down do you feel about walking and crossing roads?

- ☐ Extremely anxious
- ☐ Somewhat anxious
- ☐ Slightly anxious
- ☐ Not anxious at all.

SECTION E: COUNTERMEASURES

Now we want you to take some time to have a think about some options that might help to make you feel safer on the road. Specifically, we want you to focus on electric / hybrid vehicles and bicycles.

E.1 Please indicate your level of support for reducing vehicle speeds on the roads.

- ☐ Strongly support
- ☐ Somewhat support
- ☐ Neither support or do not support
- ☐ Somewhat do not support
- ☐ Strongly do not support

E.2 Please indicate your level of support for increasing the noise threshold for electric / hybrid vehicles.

- ☐ Strongly support
- ☐ Somewhat support
- ☐ Neither support or do not support
- ☐ Somewhat do not support
- ☐ Strongly do not support

E.3 Please indicate your level of support for increased orientation and mobility (O&M) training related to navigating electric / hybrid vehicles and cyclists.

- ☐ Strongly support
- ☐ Somewhat support
- ☐ Neither support or do not support
- ☐ Somewhat do not support
- ☐ Strongly do not support

E.4 Please indicate your level of support for increasing community awareness of the risks that electric / hybrid vehicles and cyclists pose on pedestrians who are blind or have low vision.

- ☐ Strongly support
- ☐ Somewhat support
- ☐ Neither support or do not support
- ☐ Somewhat do not support
- ☐ Strongly do not support

E.5 Please indicate your level of support for counselling services to be offered to blind or low vision pedestrians who experience stress or anxiety related to walking on the roads.

- ☐ Strongly support
- ☐ Somewhat support
- ☐ Neither support or do not support
- ☐ Somewhat do not support
- ☐ Strongly do not support

E.6 Please tell us about any other ideas you might have, which will help you feel safer on the roads when navigating electric / hybrid vehicles or bicycles.

SECTION F: DEMOGRAPHICS

F.1 Please indicate your gender:

- ☐ Female
- ☐ Male
- ☐ Other

F.2 Please indicate your age group:

- ☐ 18 to 24 years
- ☐ 25 to 34 years
- ☐ 35 to 44 years
- ☐ 45 to 54 years
- ☐ 55 to 64 years
- ☐ 65 to 74 years
- ☐ 75 years and older

F.3 What is your postcode?

____

F.4 What is your current employment status?

- ☐ Full time
- ☐ Part time
- ☐ Casual
- ☐ Not working (unemployed)
- ☐ Retired
- ☐ Student
- ☐ Volunteering (please specify full or part time):

____

F.5 What are your current living arrangements?

☐ Living alone

☐ Living with other(s), please specify who is in your household:

____

F.6 Are you currently suffering from any physical conditions?

☐ No

☐ Yes (please specify):

____

F.7 Have you been diagnosed with a mental health condition (e.g., depression, anxiety)?

☐ No

☐ Yes (please specify):

____

F.8 How would you describe your present overall health condition?

☐ Excellent

☐ Good

☐ Fair

☐ Poor

Thank you for taking the time to participate in this survey. Your responses are appreciated, and will assist us in enhancing the safe mobility of pedestrians who are blind or have low vision.

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Blindness. Low Vision. Opportunity.

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