

Synthesis title:

Mobility Impaired

Category: Drivers



Other Relevant Topics:

- ▶ Older Drivers (Drivers)
- ▶ Mobility Scooters (Riders)
- ▶ Mobility Impaired (Vehicles)

Keywords:

Mobility,
Older,
Disabled,
Impaired

About the Road Safety Observatory

The Road Safety Observatory aims to provide free and easy access to independent road safety research and information for anyone working in road safety and for members of the public. It provides summaries and reviews of research on a wide range of road safety issues, along with links to original road safety research reports.

The Road Safety Observatory was created as consultations with relevant parties uncovered a strong demand for easier access to road safety research and information in a format that can be understood by both the public and professionals. This is important for identifying the casualty reduction benefits of different interventions, covering engineering programmes on infrastructure and vehicles, educational material, enforcement and the development of new policy measures.

The Road Safety Observatory was designed and developed by an Independent Programme Board consisting of key road safety organisations, including:

- ▶ Department for Transport
- ▶ The Royal Society for the Prevention of Accidents (RoSPA)
- ▶ Road Safety GB
- ▶ Parliamentary Advisory Council for Transport Safety (PACTS)
- ▶ RoadSafe
- ▶ RAC Foundation

By bringing together many of the key road safety governmental and non-governmental organisations, the Observatory hopes to provide one coherent view of key road safety evidence.

The Observatory originally existed as a standalone website, but is now an information hub on the RoSPA website which we hope makes it easy for anyone to access comprehensive reviews of road safety topics.

All of the research reviews produced for the original Road Safety Observatory were submitted to an Evidence Review Panel (which was independent of the programme Board), which reviewed and approved all the research material before it was published to ensure that the Key Facts, Summaries and Research Findings truly reflected the messages in underlying research, including where there may have been contradictions. The Panel also ensured that the papers were free from bias and independent of Government policies or the policies of the individual organisations on the Programme Board.

The Programme Board is not liable for the content of these reviews. The reviews are intended to be free from bias and independent of Government policies and the policies of the individual organisations on the Programme Board. Therefore, they may not always represent the views of all the individual organisations that comprise the Programme Board.

Please be aware that the Road Safety Observatory is not currently being updated; the research and information you will read throughout this paper has not been updated since 2017. If you have any enquiries about the Road Safety Observatory or road safety in general, please contact help@rospa.com or call **0121 248 2000**.

How do I use this paper?

This paper consists of an extensive evidence review of key research and information around a key road safety topic. The paper is split into sections to make it easy to find the level of detail you require. The sections are as follows:

Key Facts	A small number of bullet points providing the key facts about the topic, extracted from the findings of the full research review.
Summary	A short discussion of the key aspects of the topic to be aware of, research findings from the review, and how any pertinent issues can be tackled.
Methodology	A description of how the review was put together, including the dates during which the research was compiled, the search terms used to find relevant research papers, and the selection criteria used.
Key Statistics	A range of the most important figures surrounding the topic.
Research Findings	A large number of summaries of key research findings, split into relevant subtopics.
References	A list of all the research reports on which the review has been based. It includes the title, author(s), date, methodology, objectives and key findings of each report, plus a hyperlink to the report itself on its external website.

The programme board would like to extend its warm thanks and appreciation to the many people who contributed to the development of the project, including the individuals and organisations who participated in the initial consultations in 2010.

Key facts

- In 2007 it was estimated that there were 1.7 million active licensed disabled drivers in the UK representing 5 per cent of the licensed population.
- In 2007 it was estimated that 428,000 adapted vehicles were in use in Great Britain. However, only 37,000 drivers had licences which restricted them to using adapted vehicles.

(S. Tong *et al.*, 2007)

- The risk of a disabled driver being involved in an RTI was not found to be statistically different from the risk posed to drivers in general.

(P. Henriksson and B. Peters, 2002)

- It was estimated in 2010 that around 330,000 people use mobility scooters in the UK.

(House of Commons Transport Committee, 2010)

- The majority of respondents to a UK government consultation on mobility scooters supported:
 - Introducing compulsory insurance;
 - Introducing mandatory assessment of suitability to drive;
 - Introducing mandatory driver training; and,
 - Making vehicles and users more conspicuous.

(DfT, 2010)

Summary

Mobility impaired is defined for the purposes of this synthesis as a subset of the disabled population, specifically those who have a physical or functional limitation that affects their movement about their environment. This document has been compiled to highlight and summarise road safety aspects relevant to mobility impaired drivers, primarily in the United Kingdom. There is a relatively small body of research associated with mobility impaired drivers, hence research from outside of the UK is also presented where findings are relevant and believed to be transferable.

It is estimated that 5.9 per cent of licensed drivers in the UK in 2007 were licensed disabled drivers. However, the number of active disabled drivers in the UK in 2007 was thought to be in the region of 1.7 million (5 per cent). In reaching this figure subsets of the Driver and Vehicle Licensing Agency (DVLA) database were selected which align closely with conditions linked to physical impairment; therefore this figure is thought to be representative of the number of active mobility impaired drivers.

It is estimated that there is a significantly higher number of disabled drivers in the UK than the number of adapted vehicles. This implies that many licensed disabled drivers do not use or require adapted vehicles.

It is also estimated that there is a significantly higher number of adapted vehicles in the UK than the number of drivers whose licenses actually restrict them to adapted vehicles. This implies that many mobility impaired drivers are themselves selecting adapted vehicles to make driving easier, safer or more comfortable; but license restriction is not forcing this decision.

Considering road safety, the risk of a disabled driver being involved in a Road Traffic Incident (RTI) was not found to be statistically different from the risk posed to drivers in general. An attitudinal survey of adapted vehicle owners in Sweden offers a complementary viewpoint: a large majority of respondents reported feeling safe or very safe, and that their confidence was high or very high, when driving their adapted vehicles.

Three potential areas of specific safety concern have been identified relating to mobility impaired drivers:

- Restraints for wheelchair seated drivers are inconsistently used, owing to the bespoke nature of individual applications.
- Access to and use of Emergency Roadside Telephones is a significant concern for mobility impaired users of the Highways Agency's network.
- There is a perceived problem relating to the safety of mobility scooters (in terms of risks posed to the mobility impaired driver / rider, and risks to third parties who may be involved in a collision).

The perceived problem with mobility scooters is heightened by a lack of reliable information. The number of mobility scooter users in the United Kingdom is not known and there exists a range of methods for estimating the number. An estimate of 330,000 was made in 2010 to the House of Commons Transport Committee.

Some countermeasures have been initiated to address risk from mobility scooters. An example is a training scheme provided by the Norfolk Constabulary, which appears to have had a positive effect on safe usage. However, this is based on anecdotal feedback rather than quantitative research.

Considering countermeasures more broadly, national road safety education for disabled people typically covers only those with learning difficulties or pedestrian users (i.e. not mobility impaired drivers). However, it is believed that a range of smaller educational schemes exist but are not widely known or publicised; for example specialist private driving instruction.

Engineering countermeasures, such as improved intersection design, have been shown to reduce driving errors amongst older drivers. This is relevant if it can be assumed that functional impairment of some older drivers is representative of at least some mobility impaired drivers.

Overall, little robust data exists relating to mobility impaired drivers, their level of driving, RTI involvement and degree to which their impairment has contributed to any RTIs. Lack of data makes it difficult to identify policy priorities and impossible to quantify risk.

Methodology

Mobility impaired is defined for the purposes of this synthesis as a subset of the disabled population, specifically those who have a physical or functional limitation that affects their movement about their environment. The physical or functional limitation need not be permanent; those recovering from illness, injury or surgery may be temporarily mobility impaired. The scope of this synthesis is restricted to drivers, i.e. mobility impaired pedestrians are not included.

However, some research relating to older drivers was also consulted. This was deemed appropriate where the focus is on functional limitations or mobility impairments associated with old age.

The blanket term 'mobility scooter' is used in this synthesis to cover a mobility scooter or powered wheelchair of any configuration.

This synthesis was compiled during July 2012.

A detailed description of the methodology used to produce this review is provided at <http://www.roadsafetyobservatory.com/Introduction/Methods> of the Observatory website.

The steps taken to produce this synthesis are outlined below:

- **Identification of relevant research** – searches were carried out on pre-defined research (and data) repositories. As part of the initial search some additional information sources were also consulted, which included <http://www.ingentaconnect.com>, <http://www.larsoa.org.uk>, <http://dmfed.org.uk> and <http://www.arrb.com.au>.

Search terms used to identify relevant papers included but were not limited to:

- 'Mobility impaired';
- 'Mobility';
- 'Impaired';
- 'Disabled';
- 'Disability';
- 'Wheelchair'; and,
- 'Mobility scooter'.

A total of 25 pieces of relevant research were identified.

- **Initial review of research** – primarily involved sorting the research items, based on key criteria, to ensure that the most relevant and effective items went forward for inclusion in this synthesis. Key criteria included:
 - Relevance – whether the research has adequate focus on mobility impaired drivers and road safety.
 - Provenance – whether the research is relevant to drivers, road safety policies or road safety professionals in the UK.
 - Age of research – ideally, whether the research has been published within the last 15 years. However, owing to the low quantity of available research some topical items are included which are considerably older.
 - Effectiveness – whether the research credibly proves (or disproves) the effectiveness of a countermeasure to improve mobility impaired drivers’ road safety.

Following the initial review, 21 pieces of research were taken forwards to form the basis for this synthesis.

- **Detailed review of research** – key facts, figures and findings were extracted from the identified research to highlight pertinent road safety issues and interventions.
- **Compilation of Synthesis** – the output of the detailed review was analysed for commonality and a synthesis written in the agreed format. Note that the entire process from identifying research to compiling the synthesis was conducted in a time bound manner.
- **Review** – the draft synthesis was subjected to extensive review by a subject matter expert, proof reader and an independent Evidence Review Panel appointed by DfT.

Please note that the terms Great Britain and UK have been reproduced in this synthesis as they have been used in the associated references.

Key statistics

This section collates key statistics relating to mobility impaired drivers. Most data relates to the broader category of disabled drivers, and its derivation has to be carefully considered to extract mobility impaired sub-sets.

- Across all age groups, individuals with mobility difficulties make significantly fewer trips per person per year.

(L. Avery, 2011)

Number of drivers

- It is estimated that of the 34 million licensed drivers in the UK in 2007, two million were licensed disabled drivers. In reaching this figure subsets of the DVLA database were selected which aligned closely with conditions linked to physical impairment:
 - *Limb disability – static;*
 - *Multiple sclerosis;*
 - *Arthritis;*
 - *Parkinson's;*
 - *Stroke;*
 - *Spinal injury;*
 - *Cerebral palsy; and,*
 - *Muscular dystrophy or atrophy.*
- The number of active disabled drivers in the UK was thought to be closer to 1.7 million (5 per cent). Note that these figures exclude temporarily mobility impaired drivers who, for example, may be pregnant or recovering from injuries.

(S. Tong *et al.*, 2007)

Demographics

- The mean age of disabled drivers was 57 years.
- The ratio of male-to-female disabled drivers was 61:39.

(S. Tong *et al.*, 2007)

Road traffic incidents

Only two studies were found which aligned statistics with road safety of mobility impaired drivers.

- Involvement in RTIs (of all severities) in the preceding five years was estimated at 20 per cent of the disabled driver population. However, the study notes that, “No direct comparison could be made with accidents among non-disabled populations”.
- The estimated total number of RTIs involving disabled drivers over a five year period was 383,000.
- Disability is not implied as a contributory factor in the RTIs described above. Disability as a contributory factor in fatal or injurious RTIs is recorded in between 0.1 and 0.3 per cent of instances. However, drivers with pre-existing medical conditions may be at higher risk of injury or death, and this component cannot be separated from the contributory factor records.

(S. Tong *et al.*, 2007)

- The risk of a disabled driver being involved in an RTI was not found to be statistically different from the risk posed by drivers in general.

(P. Henriksson and B. Peters, 2002)

Vehicles

Much of the data relating to vehicles for mobility impaired drivers is estimated and / or several years old, and as such should be treated with a degree of caution.

- Problems with vehicle usage were reported by 36 per cent of surveyed disabled drivers. The most frequently reported problem related to access to or egress from the vehicle (23 per cent), followed by loading and storing equipment (14 per cent) and using primary controls (eight per cent).
- One or more vehicle adaptations were reported by 22 per cent of surveyed disabled drivers. Primary adaptations (i.e. modifications to steering, acceleration, braking) were reported by 19 per cent of surveyed disabled drivers.

(S. Tong *et al.*, 2008)

- It is estimated that there were 428,000 adapted vehicles in Great Britain in 2007. There were 37,000 licensed drivers restricted to using adapted vehicles.

(S. Tong *et al.*, 2007)

- When driving their adapted vehicles, 91 per cent of respondents to one survey in Sweden reported feeling safe or very safe; 95 per cent said their confidence was high or very high.

(P. Henriksson and B. Peters, 2002)

Mobility scooters and powered wheelchairs

There are broad ranges of estimates relating to the number of mobility scooters in use in the UK. However, responses to a government consultation indicate a level of public concern surrounding their safe use.

- Mobility scooters and powered wheelchairs are defined by law in two classes:
 - Class 2 - powered wheelchairs and mobility scooters, intended for footpath or pavement use only with a maximum speed limit of 4 mph, maximum weight of 113.4kg; and,
 - Class 3 - powered wheelchairs and mobility scooters, for use on the road, with a maximum speed limit of 8 mph but with the facility to travel at 4 mph on a footpath or pavement, maximum weight of 150kg.
- A 2005 study identified a range of methods for estimating the number of mobility scooter or powered wheelchair users. Consequently, a broad range of estimates was given: of between approximately 40,000 and 100,000 mobility scooters and powered wheelchairs in use in the UK; a figure of around 90,000 was judged to be representative.
- Powered scooters and powered wheelchairs were found to be most commonly used on pavements. However, 18.5 per cent of respondents said they used a Class 2 vehicle (intended for pavement use only) on the road every day.
- Estimates on the ratio of powered wheelchairs to mobility scooters are more consistent: scooters out sell powered wheelchairs at a ratio of approximately 4:1. The UK market for mobility scooters is estimated at 25,000 vehicles per year.

(P. Barham *et al.*, 2006)

- Reporting for a parliamentary committee in 2010, a new estimate was given: 330,000 mobility scooter users in the UK.

(House of Commons Transport Committee, 2010)

- Responding to a UK government consultation on mobility scooters:
 - 72 per cent of respondents supported introducing compulsory insurance;
 - 69 per cent of respondents supported introducing mandatory assessment of suitability to drive;
 - 64 per cent supported introducing mandatory driver training;
 - 62 per cent supported making vehicles and users more conspicuous.

(DfT, 2010)

Research findings

Summaries of key findings and improvement interventions from several research reports are given below.

Highway design

- Improved intersection design has been shown to reduce driving errors amongst older drivers, specifically positive offset of left-turn lanes and protected directional turn operations of traffic lights. (This is relevant if it can be assumed that functional impairment of some older drivers is representative of at least some mobility impaired drivers).
- Other highway design interventions which are thought to improve safety for drivers with functional limitations include:
 - Conversion of intersections to roundabouts;
 - High contrast road markings;
 - Background plates for traffic signals;
 - Longer sighting distances;
 - Advance warning signs; and,
 - Protected directional turn traffic light operations.

(R. Davidse, 2007)

- Highway design aimed specifically to address the needs of particular driver groups (e.g. older or mobility impaired) should also realise broader safety benefits for other road users.

(M. King, 2000)

- Consultation with stakeholders highlighted that access to and use of Emergency Roadside Telephones is a significant concern for mobility impaired users of the Highways Agency's network.

(HA, nd)

Vehicles

- Restraints for wheelchair seated drivers are inconsistently used, owing to the bespoke nature of individual applications.

(M. Sword, 2007)

- When learning to drive joystick-controlled adapted vehicles it has been shown that reducing time lag between joystick inputs and vehicle response is the key factor in ease of learning.

(B. Peters and J. Ostlund, 2005)

- In simulator trials systems such as adaptive cruise control have been shown to reduce the workload of mobility impaired drivers without reducing safety.

(B. Peters, 2000)

Education

- Advice and training for users and purchasers of powered wheelchairs and mobility scooters was identified by focus group participants as a potentially effective safety intervention.

(P. Barham *et al.*, 2006)

- Road safety education for disabled people rarely extends beyond those with learning difficulties, or for pedestrian users (i.e. not mobility impaired drivers). Although there exist local and some national schemes (House of Commons Transport Committee, 2010), there is a shortage of provision and advice on a national basis. Some guidance is provided by the Highways Agency to customers.

(HA, nd)

How effective?

- Training schemes for mobility scooter drivers, such as that provided by the Norfolk Constabulary, appear to have a positive effect on safe usage. However, this is based on anecdotal feedback rather than quantitative research.

(House of Commons Transport Committee, 2010)

Gaps in the research

- Insufficient data exists relating to mobility impaired drivers, their level of driving, RTI involvement and degree to which their impairment has contributed to any RTIs. A relative lack of data makes it difficult to identify policy priorities and impossible to quantify risk.

(K. Williams *et al.*, 2002; House of Commons Transport Committee, 2010; DfT, 2010)

- Insufficient data exists relating to use of, and particularly RTIs involving, mobility scooters. The UK government is introducing measures to address this issue.

(House of Commons Transport Committee, 2010)

- Insufficient data exists to determine whether road safety concerns are restricting the willingness of the mobility impaired population to drive.
- There is very limited understanding of the effectiveness of education in reducing RTIs.

References

Department for Transport research and statistics

Title: National Travel Survey: Mobility difficulties by age and gender: Great Britain 2010 (Table NTS0622)
Author / organisation: L. Avery Date: Department for Transport, 2011 Format: Pdf Link: http://www.dft.gov.uk/statistics/series/national-travel-survey Free / priced: Free
Objectives: Annual survey to ascertain personal travel patterns in Great Britain.
Methodology: Survey of approximately 20,000 individuals in 8,000 households. Face to face interview and one week self-written travel diary.
Key Findings: <ul style="list-style-type: none">• Across all age groups, individuals with mobility difficulties make significantly fewer trips per person per year.
Themes: Travel, trips, mobility impaired.
Comments: Part of robust national survey.

Title: Mobility scooters and powered wheelchairs on the road – some guidance for users
Author / organisation: Department for Transport Date: 2011 Format: Pdf Link: http://www.dft.gov.uk/publications/mobility-scooters-road-guidance/ Free / priced: Free
Objectives: Advice document to raise awareness amongst users or prospective users of mobility vehicles.
Methodology: Consideration of existing rules and regulations.
Key Findings: <ul style="list-style-type: none">• Summary of rules and regulations relating to mobility vehicles and their use.
Themes: Powered wheelchair, mobility scooter, invalid carriage, highway regulations.
Comments: Summary and guidance document rather than primary research.

Title: The use of invalid carriages on highways consultation 2010 – results summary
Author / organisation: Department for Transport Date: 2010 Format: Pdf Link: http://assets.dft.gov.uk/consultations/dft-2010-10/summary-of-results.Pdf Free / priced: Free
Objectives: To set out responses received relating to this consultation.
Methodology: Government consultation: Responses to a 'tick box' questionnaire, plus 'free text' comment boxes.
Key Findings: Those responding to the consultation supported legislative changes relating to road safety, including: <ul style="list-style-type: none"> • introducing compulsory insurance, • introducing mandatory assessment of suitability to drive, • introducing training, and making vehicles and users more conspicuous.
Themes: Powered wheelchair, mobility scooter, invalid carriage, highway regulations.
Comments: This document presents findings of a consultation and is therefore limited to a presentation of views rather than a set of representative statistics or recommendations.

Other works

Title: Mobility scooters (Ninth report of session 2009-10)
Author / organisation: House of Commons Transport Committee Date: 2010. Format: Pdf Link: http://www.publications.parliament.uk/pa/cm200910/cmselect/cmtran/414/414.Pdf Free / priced: Free
Objectives: A report summarising evidence with respect to mobility scooters to determine: whether the legal position regarding use is clear; whether pedestrians and other road users are sufficiently protected by the law; and whether training or guidance on the use of the vehicles is required.
Methodology: Oral and written evidence from interest groups.
Key Findings: <ul style="list-style-type: none"> • Since a parliamentary review in 2005, the number of mobility scooters, and the number of RTIs involving mobility scooters, has increased. • Insufficient evidence exists regarding incidents and resulting injuries. • Evidence suggests that incidents tend to relate to lack of user training and problems with steering. • User training programmes do exist locally – Norfolk police's voluntary course in Great Yarmouth is presented as an example. • There is a need to clarify who is fit to drive a mobility scooter. • The legal status of mobility scooters was not found to be sufficiently clear.
Themes: Powered wheelchair, mobility scooter, invalid carriage, highway regulations.
Comments: A useful collection of contemporary primary evidence relating to the issues around mobility scooters and safety. Key finding is the lack of systematic and credible evidence relating to usage and RTIs.

Title: Safety and mobility of older road users
Author / organisation: J. Kubitzki and T. Janitzek (Allianz Deutschland AG and the European Transport Safety Council) Date: February 2009 Format: Pdf Link: http://www.etsc.eu/documents/Safety%20and%20Mobility%20of%20Older%20Road%20Users%20Final%20Report%202009_English.Pdf
Free / priced: Free
Objectives: Compilation of statistics and research to present the facts in relation to older drivers and RTIs. Contains a short section on disabled drivers in Germany (page 43).
Methodology: Consultation of German federal government mobility survey, which recorded transport modes, ages and user groups.
Key Findings: <ul style="list-style-type: none"> • There is little data on the type and extent of road use by disabled people. • However it is known that disabled people predominantly use cars and travel substantial distances.
Themes: Travel, trips, mobility impaired, transport mode.
Comments: Relates findings from an apparently robust federal survey.

Title: Data gathering on disability and driving statistics – Stage 2 (TRL 669)
Author / organisation: S. Tong, J. Broughton and R. Tong (Transport Research Laboratory) Date: 2008 Format: Pdf Link: https://trl.co.uk/reports/PPR511 Free / priced: Free
This report comprises the detailed findings for the below report, PPR 287 (TRL, 2007).

<p>Title: Data gathering on disability and driving statistics: Summary report (PPR287)</p>
<p>Author / organisation: S. Tong, R. Tong, J. Broughton (Transport Research Laboratory) Date: September 2007 Format: Pdf Link: https://trl.co.uk/reports/PPR287 Free / priced: Free</p>
<p>Objectives: The objectives of this study were to estimate the total number of disabled drivers in the UK, their demographics and experience; to estimate the number of adapted vehicles on UK roads, including type and safety of adaptations; and to estimate the number of disabled drivers involved in RTIs in the UK.</p>
<p>Methodology: Data gathering from the DVLA Driver Medical Group database with a follow up survey. Data gathering from other sources, including UK Blue Badge holders and government funded road RTI databases. Note: detailed tables and results are given in report TRL 669.</p>
<p>Key Findings:</p> <ul style="list-style-type: none"> • There are at least 1.9 million licensed disabled drivers in the UK (approximately 20 per cent of the 9.5 million disabled adult population). • Consideration of other data sources leads to an estimate of 1.7 million active disabled drivers. • Survey data suggests that there could be between 175,000 and 428,000 adapted vehicles in the UK. • RTI rates were investigated by survey: at least one RTI as a driver was reported by 20 per cent of those surveyed from the DVLA Driver Medical Group database, and by 8 per cent of Blue Badge respondents. • It was not possible to compare these results with non-disabled driving populations.
<p>Themes: Disabled driver, adapted vehicle, RTI, driving license.</p>
<p>Comments: The research covers a good range of sources and detailed results are published in some detail.</p>

Title: NHTSA research on occupant restraint for wheelchair seated drivers
Author / organisation: M. Sword (Transportation Research Centre Inc.) Date: May 2007 Format: PowerPoint Link: http://nhtsa.gov/DOT/NHTSA/NRD/Multimedia/PDFs/Public%20Paper/SAE/2007/2007%20SAE%20Gov%20Ind%20Mtg_Sword%20Wheelchair.Pdf
Free / priced: Free
Objectives: To evaluate the state of technology for restraints of wheelchair seated drivers, the restraint characteristics needed to accommodate the occupant and wheelchair, and the user needs for restraints.
Methodology: Visited vehicle modifiers and conducted eight sled tests on vehicle restraint systems.
Key Findings: <ul style="list-style-type: none"> • A common device exists for securing wheelchairs – EZ Lock – but require custom brackets for each wheelchair. • Belt application and use is wide ranging. • Varying levels of restraint are on offer – the custom application for each individual / wheelchair / vehicle modification presents challenges for effective restraint.
Themes: Wheelchair drivers, restraint systems, sled tests.
Comments: A presentation previewing preliminary results – more detailed findings may now exist. Effectively highlights the variability and restraint problems faced for wheelchair seated drivers.

<p>Title: Assisting the older driver: A literature review on intersection design elements that allow for the functional limitations of the older driver [Chapter 5.3]</p>
<p>Author / organisation: R. Davidse (SWOV Institute for Road Safety Research) Date: 2007 Format: Pdf Link: http://www.swov.nl/rapport/Proefschriften/Ragnhild_Davidse.Pdf Free / priced: Free</p>
<p>Objectives: A chapter within a broader study which aims to review junction design elements, taking into account the functional limitations of older drivers [note potential overlap with the functional limitations of mobility impaired drivers].</p>
<p>Methodology: Literature review, building on other relevant elements of the study and grouped by design elements (lighting, road marking etc).</p>
<p>Key Findings:</p> <ul style="list-style-type: none"> • Identification of highways design elements which allow for functional limitations, including: <ul style="list-style-type: none"> ○ Positive offset of opposite left-turn lanes [for countries which drive on the right]; ○ Conversion of intersections to roundabouts; ○ High contrast road markings; ○ Background plates for traffic lights; ○ Long sighting distances; ○ Advanced warning signs; and, ○ Protected-only operations of traffic lights. • However, few of these elements have been properly tested for success in the field.
<p>Themes: Functional limitations, highway design, junction design.</p>
<p>Comments: This study remains relevant to mobility impaired users by highlighting how highway design can positively influence the safety of individuals.</p>

Title: DPTAC response to consultation on the Second Three Year Review of the Department for Transport's Road Safety Strategy
Author / organisation: G. Lawson (Disabled Persons Transport Advisory Committee)
Date: November 2006
Format: Microsoft Word document
Link: http://dptac.independent.gov.uk/pubs/consult/msword/19.doc
Free / priced: Free
Objectives: Consultation response to highlight priorities for disabled transport users.
Methodology: Consultation response
Key Findings: <ul style="list-style-type: none"> • Highlights the problems of lack of data relating to disabled people and transport needs, for example in relation to risks involved in car use. • Also highlights problems of recording and reporting incidents involving mobility scooters. • Identifies need for more research into adapted vehicles.
Themes: Disabled drivers, transport use, car use.
Comments: A consultation response rather than primary research, nevertheless identifies a number of 'gaps' in the knowledge around disabled drivers and road safety.

Title: Review of Class 2 and Class 3 powered wheelchairs and powered scooters (invalid carriages) (PPAD 9/72/89)
Author / organisation: P. Barham, D. Fereday, P. Oxley (Transport & Travel Research Limited)
Date: February 2006
Format: Pdf
Link: http://assets.dft.gov.uk/publications/transportforyou-access-tipws-pwps/finalreportstage1.pdf
Free / priced: Free
Objectives: This study was carried out to provide information which the DfT could use to consider making legislative changes.
Methodology: The research was conducted in two stages. The first stage reviewed existing legislation, investigated evidence of incidents relating to such vehicles and surveyed users to ascertain how the mobility aid was used. The second stage was a consultation exercise with users, non-users and key stakeholders. Final Report Stage 1 and Final Report Stage 2 are also available separately from the above URL.
Key Findings: <ul style="list-style-type: none"> • Powered wheelchairs and scooters are exempt from road traffic regulations and user training, insurance or licensing restrictions. • Estimated that there are 70,000 to 100,000 powered wheelchair and scooter users in the UK. • Scooter sales are estimated at 25,000 per year; exceed sales of powered wheelchairs by a ratio of 80:20.

- Powered scooters and wheelchairs are most commonly used on pavements. However 18.5 per cent of respondents said they used a Class 2 vehicle on the road every day.
- Incidents involving these vehicles are thought to be heavily under-reported.
- Consultation found that
 - advice and training should be provided for purchasers
 - users should have third party insurance and
 - Class 2 vehicles should have equipment comparable to that required on Class 3 vehicles.

Themes: Powered wheelchair, mobility scooter, disabled user, incidents.

Comments: The work appears to be broad and credible, though firm recommendations are difficult given the breadth of statistical estimates regarding numbers of users and incidents.

Title: Joystick controlled driving for drivers with disabilities. A simulator driving experiment

Author / organisation: B. Peters and J. Ostlund (Swedish National Road and Transport Research Institute)

Date: 2005

Format: Pdf

Link: <http://www.vti.se/en/publications/joystick-controlled-driving-for-drivers-with-disabilities-a-driving-simulator-experiment/>

Free / priced: Free

Objectives: Investigation of alternative joy stick designs on vehicles adapted for drivers with severe disabilities, in order to establish ease of learning, ease of use and degree to which the adaptation compensates for the disability.

Methodology: Simulator study of 16 individuals with disabilities, experienced in driving but inexperienced in joystick use. Four joystick systems were trialled – interface between lateral and longitudinal control (coupled / de-coupled) and force feedback (active / passive).

Key Findings:

- There was a large variation in data with few significant differences between the systems.
- Decoupling of lateral and longitudinal control at least partly provided better control and less workload.
- Reaction to feedback forces appears to be dependent upon degree of arm and hand function and should be calibrated to the individual.
- The reduction of time lags (between joystick operation and vehicle response) enhanced learning, but decoupling and active feedback did not.
- A manoeuvre test should be included in evaluation of adaptations as a good indicator of success.

Themes: Disabled drivers, adapted vehicles, joystick systems.

Comments: A useful insight into vehicle control systems for individuals with severe mobility impairment. The sample size is small, but was constricted by the small applicable section of the driving population. The results also demonstrate the difficulty of generalising regarding vehicle adaptations – that these are best matched to the individual.

Title: An overview of the literature on disability and transport
Author / organisation: Louca-Mai Wilson (Disability Rights Commission)
Date: November 2003
Format: Pdf
Link: http://www.leeds.ac.uk/disability-studies/archiveuk/wilson%20louca/DRCTransportLitreview.Pdf
Free / priced: Free
Objectives: To provide an overview of the literature relating to transport.
Methodology: Broad review of literature relating to transportation and disabled people.
Key Findings: <ul style="list-style-type: none"> • The car is most popular mode of transport for disabled people in the UK – 90 per cent of disabled people travel by car, although only 40 per cent have a car in their household. • Whilst one third of the general public do not drive, 79 per cent of disabled people do not drive. Hence there is a level of reliance on others: 67 per cent of disabled people regularly travel in a car driven by others. • Schemes such as Motability rationalise government allowances and vehicle schemes for the disabled – Motability has almost 400,000 customers. • Reiterates findings of other studies that disabled drivers have similar RTI rates to non-disabled drivers.
Themes: Disabled drivers, transport use, car use.
Comments: Report contains only a small amount on disabled drivers and still less on road safety. However, it does demonstrate the importance of car use in transporting disabled people.

Title: Review of the road safety of disabled children and adults (TRL559)
Author / organisation: K. Williams, T. Savill and A. Wheeler (Transport Research Laboratory) Date: 2002 Format: Pdf Link: https://trl.co.uk/reports/TRL559 Free / priced: Free
Objectives: A review of the available information on road safety of children and adults with disabilities.
Methodology: Literature search, web search and discussions with professionals working for charities, local authorities and universities. Focus on prevalence of types of special need, road RTI risk and development of remedial measures.
Key Findings: <ul style="list-style-type: none"> • Data on prevalence of various disabilities, their RTI involvement and exposure are largely unavailable so concludes that it is difficult to quantify the extent of risk of RTI involvement. • Road safety education measures for disabled people are mostly for those with learning difficulties – the types of training found to be most appropriate are discussed. Training resources for wheelchair users also identified. The resources that exist for disabled children and adults have not generally been evaluated or made widely available. Refers to mobility and independence training course by Northamptonshire for adults including those in wheelchairs. Found no schemes for disabled people not in wheelchairs. • Engineering measures for disabled people focus on the pedestrian environment. Shropshire planning to improve provision for disabled cyclists. • Concludes that there are insufficient data to identify policy priorities. Quantifying risk would be a major task. Seems reasonable to conclude that some disabled people are at increased risk in the pedestrian environment (no comment on driving risk). • Recommends guidance on road safety education for disabled people should be issued.
Themes: Disabled adult, disabled children, RTI risk, safety, education.
Comments: This wide ranging review highlights how most research has been carried out with a focus on disabled pedestrians rather than as drivers. Emphasises consequent difficulty in ascertaining road safety risk for the disabled population.

Title: Drivers with disabilities – their cars, driving habits and safety
Author / organisation: P. Henriksson and B. Peters (Nordic Road and Transport Research)
Date: 2002
Format: Pdf
Link: http://www.vti.se/en/news-archive/english-news-archive/63/ [summary only]
Free / priced: Free
Objectives: To gather data on driver's specific disability, their vehicle and any modifications, and their RTI involvement.
Methodology: Survey of 1,000 disabled drivers in Sweden.
Key Findings: <ul style="list-style-type: none"> • When driving their adapted vehicles, 91 per cent reported feeling safe or very safe; 95 per cent said their confidence was high or very high. • The proportion of drivers involved in RTIs during the period 1996 to summer 1999 was 11 per cent. The majority were minor RTIs: in 84 cases (87 per cent), only material damage was the consequence. • Like young drivers in general, young disabled drivers were more often involved in RTIs than middle-aged and older drivers. A group of disabled drivers which was overrepresented among those drivers who had experienced an RTI comprised persons with impaired or no function in the abdomen, such as persons with a spinal cord injury. • Nine RTIs were attributed to problems with the special equipment in the car. The causes could be unfamiliarity with the controls, an adaptation that was insufficiently adjusted to the individual or equipment that broke down. In three of the four cases with technical defects of the equipment, a combined control for braking and accelerating was found in the car. • The risk of a disabled driver being involved in an RTI was not found to be statistically different from the risk posed to drivers in general.
Themes: Disabled drivers, safety, adapted vehicles.
Comments: This study does not record any additional risks posed by disabled drivers. It also investigated opinions on confidence and safety amongst drivers which are not widely reported in other research.

Title: Adaptation evaluation – An Adaptive Cruise Control (ACC) system used by drivers with lower limb disabilities
Author / organisation: B. Peters (Swedish National Road and Transport Research Institute) Date: November 2000 Format: Pdf Link: http://www.iatss.or.jp/Pdf/research/25/25-1-06.Pdf Free / priced: Free
Objectives: Investigation of how ACC influenced workload, comfort and driving behaviour for drivers with disabilities.
Methodology: Simulator study of 20 individuals with disabilities who were experienced in driving adapted vehicles (completed at least 40,000 km). Subjects drove 100km on two lane roads with and without ACC and were asked to react to certain triggers along the route by braking.
Key Findings: <ul style="list-style-type: none"> • Subjective workload was lower and performance better when using the ACC system. • Subjects felt they could control speed and distance to leading vehicles better when using ACC. They trusted the system. • Use of ACC did not influence reaction time, speed, or lateral position. • The study concludes that ACC decreases workload, increases comfort without a negative effect on safety.
Themes: Disabled drivers, adaptive cruise control, driving simulator.
Comments: Study goes some way to proving the anticipated benefits of adaptive cruise control. However the sample is small and it could be argued that a simulator trial does not fully replicate using and trusting such technology in a 'real world' situation.

<p>Title: The Iceberg Principle: The knock on effects of addressing the safety of “special needs” road users Proc. Road Safety Research Policing and Education Conference, pp 359-364</p>
<p>Author / organisation: M. King Date: 2000 Format: Pdf Link: http://eprints.qut.edu.au/9522/ Free / priced: Free</p>
<p>Objectives: To estimate wider potential benefits for other road users when problems for special needs road users are addressed.</p>
<p>Methodology: Five years’ RTI data was examined to produce odds ratios for collision types by age group, time and location. This is used to argue that reducing the risk of RTI involvement for older drivers at intersections will also prevent other casualties. A similar approach is taken to considering RTIs involving child pedestrians. The study is written from the perspective of making engineering interventions.</p>
<p>Key Findings: Focussing engineering interventions on particular groups (whose needs would not otherwise necessarily be targeted) should bring wider benefits to other road user populations.</p>
<p>Themes: Older drivers, RTI risk, highway interventions.</p>
<p>Comments: The approach taken may be relevant for mobility impaired populations, for example specifically considering their needs when intervening at an oblique intersection. The principle of the study is sound, although the content is relatively simplistic.</p>

Title: Evaluating drivers licensed with medical conditions in Utah, 1992 - 1996
Author / organisation: E. Diller, L. Cook, D. Leonard, J. Reading, J. Dean and D. Vernon (Utah CODES, US Department of Transportation) Date: June 1999 Format: Pdf Link: http://ntl.bts.gov/lib/25000/25900/25974/DOT-HS-809-023.Pdf Free / priced: Free
Objectives: Comparison of citation, RTI and at fault RTI rates of restricted and unrestricted drivers with medical conditions, to inform future licensing restriction conditions.
Methodology: Use of comparison group and probabilistic linkage to derive rates and relative risks. The work deals with different categories of disability separately, not all are relevant to mobility impairment.
Key Findings: <ul style="list-style-type: none"> Typically disabled drivers exhibited higher RTI rates or risks than the comparison groups, though not by a significant margin.
Themes: Medical conditions, licensing, RTI rate.
Comments: Small sample numbers for disabilities linked to impairment of mobility; however confidence intervals stated to allow fair assessment. One of the only studies which appears to show that disabled drivers may be at increased risk of RTI involvement.

Title: Assessment of vehicle safety problems for special driving populations: Final report
Author / organisation: A. J. McKnight, M. A. Green, F. Masten, and R. J. Koppa (US Department of Transportation) Date: February 1979 Format: Pdf Link: http://ntl.bts.gov/lib/25000/25500/25517/DOT-HS-804-918.Pdf Free / priced: Free
Objectives: To identify driving problems related to vehicle operation encountered by physically limited drivers.
Methodology: Face to face interviews of over 500 drivers across four areas of the US.
Key Findings: The study reports difficulties using primary and secondary controls as well as difficulties in checking blind spots and mirrors.
Themes: Disabled drivers, adapted vehicles, vehicle adaptation devices.
Comments: Owing to the age of the report many of the recommendations are likely to have been addressed by the advance of vehicular technology – for example the report pre-dates widespread use of power steering, hence difficulties steering were widely reported.

Title: The safety of physically disabled drivers
Author / organisation: L. Ysander Date: British Journal of Industrial Medicine 1966, 23, 177, 1966 Format: Pdf Link: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1008426/ Free / priced: Free
Objectives: To investigate the frequency of traffic RTIs for disabled drivers and compare to a control group.
Methodology: Carried out in Sweden. Extensive investigation of licensing and RTI records of almost 500 individuals over a 10 year period. Due to practical considerations the control group could not be considered a representative sample for the disabled sub-populations.
Key Findings: <ul style="list-style-type: none"> • The study found only three RTIs which may have been caused by the driver's disability. This constitutes 0.6 per cent of all drivers investigated. • The frequency of all RTIs was 7.1 per cent in investigated and control series; serious RTIs 12.2 and 14.8 per cent in the investigated and control series respectively. • The study concludes that disabled drivers are not an increased hazard.
Themes: Disabled drivers, RTI frequency.
Comments: Although dated, this study considers records over a long period. The control group sample, although not ideal was matched as far as possible for age, sex and years' driving experience.

Title: Disability Accessibility of the strategic road network
Author / organisation: Highways Agency Date: [no date] Format: Pdf Link: http://www.highways.gov.uk/knowledge/documents/DDA_Web_Printer.Pdf
Free / priced: Free
Objectives: A communications document summarising actions taken and actions pending regarding improving accessibility of the Highways Agency network.
Methodology: Response to Disability Discrimination Act, including consultation with stakeholders.
Key Findings: <ul style="list-style-type: none"> • Of particular relevance to mobility impaired drivers: <ul style="list-style-type: none"> ○ that Emergency Roadside Telephones are accessible and ○ can be used by people with varying disabilities.
Themes: highway engineering, Disability Discrimination Act, roadside telephones
Comments: No statistical content but a summary of responses and priority areas relevant to highway engineering for disabled road users.

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