

OLDER DRIVER COHORT DIFFERENCES: OLDER DRIVERS IN 2030

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1. A BRIEF STATEMENT OF THE ISSUE

Much of our understanding of the so-called 'older driver problem' is based on a projection of current older driver patterns. However, there is growing evidence that the emerging 'Baby Boomer' cohort of older drivers (those born from 1946 to 1965 inclusive) will be different from previous groups. This paper explores the changing trends and identifies some arising road safety implications.

2. AN ASSESSMENT OF THE ROAD SAFETY ISSUE

2.1 Demographic Changes

In the year 2030, the youngest of the Baby Boomers will be nearing their sixty-fifth birthday, making approximately 29% of the Australian population aged 65 years or older. This compares to approximately 15% of the population in 2006, signifying a near doubling in the number of older Australians (Australian Bureau of Statistics, 2006b). Additionally, six times as many people will be 90 years or older in 2030 than at present (Australian Bureau of Statistics 2006a). There will be 1.3 times more women over 80 years old than men in 2030 (Australian Bureau of Statistics 2006a). These ageing individuals are also expected to retire later and live independently for longer than previous cohorts.

2.2 Changes in Driving Patterns

Possible cohort differences include:

- Longer life spans accompanied by increased health well into old age, although it may be that health improvements will not keep up with extended life spans. This would have a two-fold implication for future crash rates: better health for some older drivers but, at the same time, increased years of driving for some with severe health impairments
- Baby Boomers retiring later and with greater disposable income – and therefore likely to have more active lifestyles and greater demands for personal mobility.
- Baby Boomers less willing to adapt their amount and type of driving in response to reduced travel needs and driving skills
- Baby Boomers with smaller and more dispersed families, meaning that the traditional carers and transporters of older people (children, and especially daughters) will not be so readily available
- The amount of driving done by females rising, without necessarily a commensurate reduction in the amount of driving done by males.
- More 'ageing in place,' often in outer suburbs with reasonably dispersed facilities and limited alternative transport options.
- Improvements in vehicle safety, especially crashworthiness, providing increased protection to older drivers in the event of a crash.

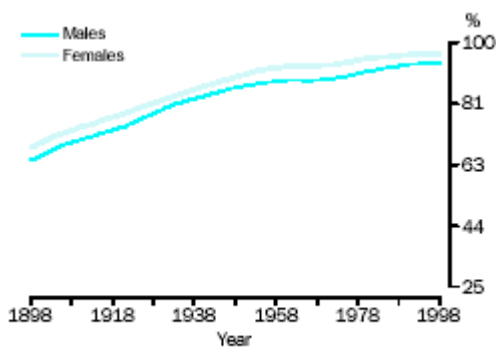
3. A REVIEW OF THE RESEARCH

Expected changes have been classified herewith into nine topic areas. The research in each of these topic areas is summarised and its expected influences on road safety and older driver behaviour are discussed. Policy initiatives and future directions are also summarised.

3.1 Longevity and Health

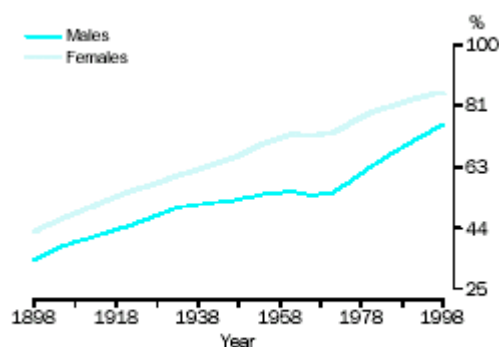
More of the population is living to age 65 and older than ever before (Australian Bureau of Statistics 2002, see Tables 1 and 2). Many older Australians live healthy, productive lives into their later years due to the increasing awareness of health risks, improved diets and changes in lifestyle as a result of the early detection of health problems (Australian Bureau of Statistics 1999). Baby Boomers are also more concerned with successful ageing than previous generations, who tended to think of a decline in their functional abilities as inevitable (Valliant & Mukamal 2001).

Table 1: Proportion of people surviving to age 50 by Year



Source: Deaths Australia (various), Cat. no. 3302.0.

Table 2: Proportion of people surviving to age 70 by Year



Source: Deaths Australia (various), Cat. no. 3302.0.

The older generation of 2030 is also likely to be better educated, as the rate of post-school qualifications (including skilled and technical training) among Baby Boomers is 1.6 times greater than that of the current cohort of older people. In 2005, women aged 50 - 59 were five times more likely to have a bachelor's degree or above than the female cohort of that age in 1984 and for men it was a three-fold increase (Australian Bureau of Statistics 2006b). As there is a strong correlation between education level and health in later life (Valliant & Mukamal 2001), the higher education levels of the Baby Boomer cohort are likely to be associated with improved physical health and ability to cope with disabilities.

Additional lifestyle factors, such as decreased rates of drinking and smoking, particularly among Australian men, and social networks are also likely to play a role in the Baby Boomer's long-term health status (Quine & Carter 2006; Giles et al 2004; Woo et al 2005).

Approximately 23% of Australians over the age of 65 currently report having a disability affecting their core activities (Australian Bureau of Statistics 2003) – with 17.3% also requiring assistance with transport. As the rate of disability tends to be compressed among older age groups (Fries 1980), the greater number of people living into their older years means that the number of individuals with disabilities is expected to grow at least in absolute terms. This prospect is given greater urgency by projections showing profound disability from stroke, musculoskeletal, nervous system, circulatory, respiratory, and conditions related to vision, to nearly double between 2006 and 2031 among certain sub-populations in Australia (Giles et al 2006). Notwithstanding these

predictions, it is unclear how advances in medicine, through disease prevention, pharmaceuticals, and surgical treatments, may reduce the need for long-term care and impact upon disabled people's mobility (Metz 2000).

Though many Baby Boomers are likely to be healthy in their older years, a minority will be adversely affected by chronic disease and disability. Therefore, it is important to consider how best to equip the unwell sub-population with transportation alternatives without compromising the mobility of those who are still well enough to drive safely.

3.2 Working into later years and wealthier

For people aged 50–59 years, participation in the labour force has increased from 61% in 1984 to 71% in 2004 - with women's participation growing from 37% to 62%. Of women aged 65 years and older, 4% were employed in either part-time or full-time positions, a doubling of the percentage in 1979 (Australian Bureau of Statistics 2006).

Along with older people's increasing participation in the workforce comes an increase in the amount of their work-related travel. Data from the United States for example, already reflect an increased number of work-related trips for older women with 11% of trips made by women aged 60–64 years for work-related purposes in 1996 - 98, as compared to 8% in 1985- 86. This trend is likely to become more pronounced, as Baby Boomers retire later and more women work into their older years.

It also important to note that fatal highway incidents were the most frequent cause of work-related deaths, accounting for 22% of work-related deaths in the United States and 31% of work-related deaths in Australia 1989-1992 (Driscoll et al 2005). With more work-related travelling, it is probable that the number of work-related road deaths will increase among older drivers.

3.3 Travelling More

Beyond the expected increase in the number of work-related trips, it is expected that older Baby Boomers will also be driving more for other purposes. Burkhardt & MacGavock (1999) have demonstrated that the number of vehicle miles travelled (VMT) by people 65 years and older is on the rise, with an increase of 26% between 1983 and 1990 in the United States. Hu et al (2000) have predicted a 151.3% increase in the mileage driven by people in the 65-69 year old age category between 1995 and 2025 – with a 127% increase for drivers aged 85 years and older.

Similarly, the Australian Bureau of Statistics Survey of Motor Vehicle Use has shown an 8.5% increase in driving distances from October 2001 to 2005 for drivers of all ages, which might persist as today's Baby Boomers reach old age (Australian Bureau of Statistics 2005). Because licensing rates of people over age 65 years are on the rise, a downward trend in the use of alternative transportation modes and further increases in driving have been predicted (Rosenbloom & Morris 1998).

With age, travel for medical purposes has also been shown to increase. One percent of American men and 1.6% of American females aged 16-64 years made trips for medical purposes in 2001, compared to 2.5% and 4.0% of men and women, respectively, aged 65 – 69 years. This figure was higher at 5.8% and 5.4% for men and women respectively aged 85 years and older. As the demand for health care services is expected to grow among the Baby Boomer cohort (Schofield & Earnest 2006), so should the number of trips for medical and allied health purposes.

3.4 Licensing Rates

The licensing rates of older people have been steadily increasing with each birth cohort, as car travel becomes more prevalent and more people have grown up using and owning cars. In the United States, men aged 85 years and older holding licences went from 47.5 % in 1983 to 71.7 % in 1996, with women in this age group rising from 11.7 % to 28.5% (Burkhardt & MacGavock 1999). This trend has also been demonstrated using Australian licensing data (Fildes 1997). Using the 1996 licensing rates as the reference, a 2.5 times increase in the number of 65 plus year-old drivers and a 3.5 times increase in the number of 85 plus year-old drivers on the road in 2030, has been predicted (Burkhardt & MacGavock 1999).

3.5 Public Transportation Use

Along with increasing licensing rates, it seems that older peoples' use of public transport and other means of transport is dropping with each successive cohort. Between 1995 and 2001, the use of public transportation by older people in America dropped by almost 50% (Rosenbloom 2005).

The decreasing use of alternative transportation is consistent with society's growing dependence on cars and with the physical difficulties encountered by older people in using alternative modes of transport, such as public transport or walking. A telephone survey in Michigan showed that 94.8% of elderly non-drivers' most common transport option was being driven by friends and family, with special transport services accounting for the remaining 5.2% (Kostyniuk & Shope 2003). Furthermore, driving is generally the last transport mode that older people will surrender, after public transport and walking (OECD 2001).

3.6 Female drivers

While women are less likely to hold a licence than men in most age groups, this is most pronounced among older women. In 2000, 20% of Victorian women aged 80 years and older held licences, compared to 65% of men. (Oxley et al, 2004). The gap between men and women who hold licences has been narrowing among younger cohorts (Raymond et al 2001; Massie et al 1995). Using American licensing data, Mayhew et al (2003) showed that licensing for women had increased by 32% from 1975 to 1998 and the gender differences had "virtually disappeared" in the older cohort by 1998 with women representing almost 50% of the licensed drivers.

Unequal licensing rates are not the only current differences between male and female older drivers: licensed female drivers often let their male counterparts do the majority of the driving while they remain passengers and older men are 2 to 3 times more likely to be a driver than women (Rosenbloom, 1995). This trend declines after women reach age 70, as their male partners die or otherwise lose their ability to drive. Data have shown that women taking up driving in their older years can often represent a heightened crash risk, as they may not be as confident or skilled after years of being in the passenger role (Oxley et al 2004).

However, the current differences in travel and crash patterns between men and women may decrease, as many Baby Boomer women will have 'life-long' driving experience that is more comparable with men's driving experience. The increasing rate of divorce also means that fewer Baby Boomer females will have been reliant upon their husbands for doing the majority of driving. The numbers of one-person and single-mother households with children under 15 have both increased between 1988 and 1998, making a larger proportion of women the sole driver for their household (Australian Bureau of Statistics 1999). The 2001 NHTSA data also show a decline in the gap between vehicles miles driven for men and women with women's mileage increasing at a rate greater than men's, suggesting the experience gap will be smaller in the years ahead (Rosenbloom 2006).

3.7 'Ageing in place'?

Increasing numbers of elderly people are choosing to live at home perhaps with home-based support, rather than in nursing homes or residential accommodation (Bishop 1999). In 1998, 94.1% of all individuals over the age of 65 resided at home with only 22% reporting that they required assistance with transport (Australian Bureau of Statistics 1999). Of people aged 85–89 in 1996, 29% of women and 18% of men lived in cared accommodation (Australian Bureau of Statistics 1999).

It is unclear where Australian Baby Boomers will reside in retirement. Some suggest 'ageing in place' or remaining in the family home, while others predict downsizing the family home for financial reasons. Regardless of the type of dwelling, 64% of older Australians in 1996 lived in urban settings, and this trend is expected to continue among the Baby Boomers (Australian Bureau of Statistics 1999). As residents of urban or lower density suburban areas, it is expected that there may not always be adequate access to public transport and most driving will take place on highways and in areas of high traffic volume (Rosenbloom 1995). As older drivers are known to have difficulties with intersections and merging/lane changes (Staplin 2001), increased use of especially urban streets may pose more substantial crash risk to themselves and their passengers (as distinct from other road users).

3.8 Cars

In Australia, the number of registered vehicles rose by 12.5% between October 2001 and October 2005 (Australian Bureau of Statistics 2005). Most of this rise is attributed to the increasing affluence of Baby Boomer households and multiple-car ownership, more Baby Boomer women owning their own vehicles and increasing licensing and driving rates in older years (Spain 1997).

The types of cars driven by Baby Boomers are also likely to change. Data from the US national household travel survey has shown that in 2001 older people were more likely to own older cars (McGuckin & Liss 2005). The average age of passenger vehicles in America rose from 5.5 years to 8.23 years between 1977 and 1995 (Pickrell & Schimek 1997). However current vehicles, as a group, are twice as safe as vehicles manufactured some thirty years earlier (Newstead et al 2003). If these trends in improved vehicle design continue, Baby Boomer ownership of safer more crashworthy vehicles may well contribute to reduced crashes and injuries among elderly.

3.9 More comfortable with driving & technology

In addition to the improved design of modern vehicles, the driving skills of Baby Boomer may be better than their predecessors. Stamatiadis and Deacon showed that the relative safety of older drivers improved between 1978 and 1988 based on a study using Michigan crash records⁴¹ (Stamatiadis & Deacon 1995). They concluded successive cohorts may be safer due at least in part to their increased comfort level with driving. As many Baby Boomers have been driving from a young age, they may not experience the anxieties felt by previous generations, who would not have started to drive regularly or owned a car until later on in their lives.

Another study in Finland looked at insurance claims for motor vehicle crashes at intersections among older drivers, the most common crash type for older drivers. For male drivers aged 60-79, the effect of increased crashes at intersections was delayed in the successive cohort. For women, the rates of intersection crashes also decreased among the later cohort of 60-69 year olds. However, a decrease in the rates of intersection crashes was not found for men over 80 or women over 75 years (Hakamies-Blomqvist & Henriksson 1999).

In addition to improved skill, Advanced Driver Assistance Systems (ADAS) and In-Vehicle Information Systems (IVIS) have both been shown to have potential for enhancing older drivers' safety by helping to compensate for medical concerns and conditions associated with ageing (Koppel, 2006). Among these, some promising solutions include collision warning systems at intersections that have the ability to alert drivers to oncoming hazards; automated lane changing and merging systems to assist older drivers with difficulties in passing zones; blind spot and obstacle detection systems that may assist drivers with limited sight; road and route information systems that can enable drivers who have difficulties with way-finding; parking guidance systems for those who have limited sight and movement; and driver condition monitoring to measure fluctuations in sleepiness, cognitive load and factors associated with medications (Davidse R, 2006; Shaheen and Niemeier, 2001).

4. POLITICAL, SOCIAL AND OTHER FACTORS

Both the increasing number and changing lifestyles of ageing Baby Boomers are all likely to impact various aspects of driving and road safety, and the final outcome remains unknown. These changing patterns deserve attention, as many transport policies and road safety initiatives are based on current trends in older driver road usage and behaviour. Social institutions such as public transportation, licensing authorities and community assistance agencies need to be prepared for the changing transportation needs of older generations to come, so that the minority of older people who are no longer fit to drive safely can maintain their lifestyle without being dependent on cars for their transport.

4.1 Age vs Functional Impairment

There is no reasonable doubt that certain sub-groups of older drivers may be at an increased crash risk due to functional impairments related to age (Janke 1994; Janke & Eberhard 1998; Rabbitt 1993; Waller 1992). Given the growing number of older Baby Boomers, an important policy problem is therefore how best to identify those drivers whose functional or medical fitness may put them at risk.

Age-based mandatory assessment of older drivers is used by jurisdictions in Australia. Some research has shown similar road safety benefits between those with aged-based assessment and those without age-based assessment.

Alternative options for assessing older drivers are being investigated. Licensing models involving multi-level assessment of drivers giving indications of being at-risk, are currently being developed and evaluated around the world and appear to hold considerable promise (Janke & Eberhard 1998; Staplin et al 2003b; MUARC 2004).

4.2 Options for Older Drivers

The question still remains as to how the growing number of functionally impaired older drivers will cope with driving once their health starts to decline. With the data showing that most people who are not fit to drive are also no longer fit to walk or ride on public transportation, other options need to be investigated as a matter of urgency.

For persons with disease or trauma from which they can recover, rehabilitation with or without adaptive equipment has been shown to allow individuals to regain enough function to permit at least restricted driving. A systematic review of eight driver re-training programs showed fair evidence for physical re-training (e.g. range of motion training), and to a lesser extent, limited evidence for visual perception re-training and for driving awareness and behaviour educational interventions (Kua et al 2007).

While rehabilitation and educational interventions may provide solutions for people who are well enough to cope with driving, other alternatives need to be sought for those who are too unwell to operate cars even on a limited basis. For many older people, not having the ability to drive is a major risk factor for entering long term care (Freeman et al 2006). As public transportation is not always a realistic alternative for elderly people who are not mobile enough to get to and from bus or trains stations, low cost or volunteer taxis, driver services and share-a-ride facilities should be explored.

5. CONCLUSIONS

Clearly, Baby Boomer drivers will have some markedly different travel patterns and risk factors when compared to previous generations of elderly people. Not only will their amount of travel increase due to extended years of working, more female drivers on the road and increasing licensing rates, but trip length may also increase as disposable income grows and more people live in the suburbs into their later years. Certain factors, such as the burden of disability among older Australians, are still unclear and further research will be required to determine how this will impact travel patterns into the future.

Licensing and transport authorities need to prepare for the surge in numbers of elderly drivers, as well as their changing lifestyles and travel needs. Whether training packages or alternative transportation modes will best help those that are no longer fit to drive remains to be seen.

REFERENCES

- Australian Bureau of Statistics 1999, *Older People Social Report* Cat No. 4109.0 Available at: <http://www.abs.gov.au> Accessed 11 May, 2007.
- Australian Bureau of Statistics 2002, *Measuring Australia's Progress* Cat No. 1370.0 Available at: <http://www.abs.gov.au> Accessed 11 May, 2007.
- Australian Bureau of Statistics 2003, *Disability, Ageing and Carers* Cat No.4430.0 Available at: <http://www.abs.gov.au> Accessed 11 May, 2007.
- Australian Bureau of Statistics 2003, *Household wealth and wealth distribution* Cat No. 6554.0 Available at: <http://www.abs.gov.au> Accessed 11 May, 2007.
- Australian Bureau of Statistics 2005, *Survey of Motor Vehicle Use* Cat No. 9208.0 Available at: <http://www.abs.gov.au> Accessed 11 May, 2007.
- Australian Bureau of Statistics 2006a, *Australian Social Trends* Cat No. 4102.0 Available at: <http://www.abs.gov.au> Accessed 11 May, 2007.
- Australian Bureau of Statistics 2006b, *Population Projections, Australia 2004 TO 2101* Cat No. 3222.0. Available at: <http://www.abs.gov.au> Accessed 11 May, 2007.
- Bishop CE 1999, Where Are The Missing Elders? The Decline in Nursing Home Use, 1985 And 1995, *Health Affairs*, vol. 18, no. 4, pp. 146.
- Bishu RRB, Foster B & McCoy PT 1991, Driving Habits of the Elderly – A Survey in the Proceedings of the Human Factors and Ergonomics Society, 35th Annual Meeting, September, San Francisco, California, Vol. 1, pp. 1134-1138.
- Burkhardt JE & MacGavock AT 1999, Tomorrow's older drivers: Who? how many? what impacts?, *Transportation Research Record*, 1693, pp. 62–70.
- Burns P 1999, Navigation and Mobility of Older Drivers, *Journal of Gerontology: Social Sciences*, 54B, pp. S49- S55.
- Davidse RJ 2006. Older Drivers and ADAS: Which systems improve road safety? *IATSS Research*, 30(1), pp: 6 - 20.
- Driscoll T, Marsh S, McNoe B, Langley J, Stout N, Feyer A-M & Williamson A 2005, Comparison of fatalities from work related motor vehicle traffic incidents in Australia, New Zealand, and the United States, *Injury Prevention*, vol. 11, pp. 294–299.
- Evans L 1993, How Safe Were Today's Older Drivers When They Were Younger? *American Journal of Epidemiology*, vol. 137, no. 7, pp. 769-775.
- Fildes B 1997, Safety of Older Drivers: Strategy for future research and action initiatives. MUARC Report No. 118, Monash University Accident Research Centre, Clayton, Victoria.
- Freeman EE, Gange SJ, Munoz B & West SK 2006, Driving status and risk of entry into long-term care in older adults, *American Journal of Public Health*, vol. 96, no. 7, pp.1254-9.
- Fries JH 1980, Aging, natural death, and the compression of morbidity, *New England Journal of Medicine*, vol. 303, pp. 130-135.
- Giles LC, Cameron ID & Crotty M 2003, Disability in older Australians: projections for 2006–2031. *Medical Journal of Australia*, vol. 179, no. 3, pp. 130-133.

- Giles LC, Metcalf PA, Glonek GF, Luszcz MA & Andrews GR 2004, The effects of social networks on disability in older Australians, *Journal of Aging and Health*, vol. 16, no. 4, pp. 517-38.
- Hakamies-Blomqvist L & Henriksson P 1999, Cohort effects in older drivers' accident type distribution: Are older drivers as old as they used to be? *Transportation Research Part F: Traffic Psychology and Behaviour*, vol 2, no. 3, pp. 131-8.
- Hu PS, Jones DW, Reuscher T, Schmoyer Jr. RS, & Truett LF 2000, Projecting Fatalities in Crashes Involving Older Drivers, 2000-2025 8-10. Oak Ridge National Laboratory, The Center for Transportation Analysis. Report No. ORNL-6963.
- Janke MK, Eberhard JW 1998, Assessing medically impaired older drivers in a licensing agency setting, *Accident Analysis and Prevention*, vol. 3, pp. 347-61.
- Janke MK 1994, *Age-related disabilities that may impair driving and their assessment*. Literature review. Sacramento: California Department of Motor Vehicles.
- Koppel S, Charlton J, Muir C, Oxley J, Fildes B, Scully J & Tomasevic N 2006, Solutions for Older Driver issues: Design-Technology-Training, Melbourne: AutoCRC.
- Kostyniuk LP & Shope JT 2003, Driving and alternatives: Older drivers in Michigan, *Journal of Safety Research*, vol. 34, no. 4, pp. 407-414.
- Kua A, Korner-Bitensky, N, Desrosiers, J, Man-Son-Hing, M, and Marshall, S 2007, Older driver retraining: A systematic review of evidence of effectiveness, *Journal of Safety Research*, 38, 1, pp. 81-90.
- Massie D, Campbell K & Williams A 1995, Traffic accident involvement rates by driver age and gender, *Accident Analysis and Prevention*, vol. 27, no. 1, pp. 73-87.
- Mayhew D, Ferguson S, Desmond K & Simpson H 2003, Trends in fatal crashes involving female drivers, 1975-1998, *Accident Analysis and Prevention*, vol. 35, pp. 407-415.
- McGuckin N & Liss S 2005, Aging Cars, Aging Drivers: Important Findings from the National Travel Household Survey, Institute of Transport Engineers, *ITE Journal*, September 2005.
- Metz D 2000, Innovation to prevent dependency in old age. Technological innovations may reduce the cost burden of an ageing population, *British Medical Journal*, vol. 320, no. 7233, pp. 460-1.
- Monash University Accident Research Centre 2004, *Model Licence Re-Assessment Procedure for Older Drivers: Stage 2 research*, No. AP-R259/04, AustRoads Incorporated, Sydney.
- Newstead SV, Cameron MH, Watson LM & Delaney AK 2003, *Vehicle Crashworthiness and Aggressivity Ratings and Crashworthiness by Year of Vehicle Manufacture: Victoria and NSW Crashes During 1987-2000, Queensland and Western Australia Crashes During 1991-2000*. MUARC Report No. 196, Monash University Accident Research Centre, Clayton, Victoria
- Organisation for Economic Development (OECD) 2001, Ageing and Transport. *Mobility needs and safety issues*. Paris: OECD Publications.
- Oxley J, Charlton J, Fildes B, Koppel S, Scully J 2004, *Older women and driving: a survey*, Report No. 226, Monash University Accident Research Centre, Clayton, Victoria.
- Pickrell D & Schimek P 1998, Trends in Personal Motor Vehicle Ownership and Use: Evidence from the Nationwide Personal Transportation Survey, pp.1 – 35.
- Quine S & Carter S 2006, Australian baby boomers' expectations and plans for their old age, *Australasian Journal on Ageing*, Vol 25, No 1, pp. 3 - 8.
- Rabbitt P 1993, Does it all go together when it goes? The nineteenth Bartlett Memorial Lecture. *Quarterly Journal of Experimental Psychology*, 46A, pp. 385-434.

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- Raymond A, Knoblauch R, & Nitzburg M 2001, *Older road user research plan*, Research Report No. DOT HS 809 322, National Highway Traffic Safety Administration, Washington DC.
- Rosenbloom S 1995, *Travel by the elderly*. In Office for Highway Information Management (Ed.), *Nationwide Personal Transportation Survey, Demographic Special Reports*, (pp. 3-1 to 3-49). Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.
- Rosenbloom S & Morris J 1998, Travel Patterns of Older Australians in an International Context: Policy Implications and Options, *Transportation Research Record*, vol. 1617, pp. 189-93.
- Rosenbloom S 2005, 'The mobility needs of older Americans: implications for transportation reauthorization' in *Taking the high Road: a metropolitan agenda for transportation reform*, Katz B & Puentes R (Eds.), Brookings Institution Press, Washington D.C.
- Rosenbloom S 2006, Is the Driving Experience of Older Women Changing? Safety and Mobility Consequences over time. *Transportation Research Record: Journal of the Transportation Research Board*, 1956, pp. 127-32.
- Schofield DJ & Earnest A 2006, Demographic change and the future demand for public hospital care in Australia, 2005 to 2050, *Australian Health Review*, vol. 30, no. 4, pp. 507-15.
- Shaheen SA and Niemeier DA (2001). Integrating vehicle design and human factors: minimizing elderly driving constraints, *Transportation Research Part C*, 9, pp: 155-74.
- Spain D 1997, *Societal trends: The aging baby boom and women's increased independence*, DTFH61-97-P-00314, University of Virginia, Charlottesville, VA.
- Stamatiadis N & Deacon JA 1995, "Trends in Highway Safety: Effects of an Ageing Population on Accident Propensity, *Accident Analysis and Prevention*, vol. 27, pp. 443-459.
- Staplin L, Lococo K, Byington S et al. 2001, *Highway Design Handbook for Older Drivers and Pedestrians*. Washington, DC: Federal Highway Administration.
- Staplin L, Lococo K, Gish K, & Decina L. 2003a, *Model Driver Screening and Evaluation Program. Final Technical Report. Volume 2: Maryland Pilot Older Driver Study*. Washington D.C.: National Highway Traffic Safety Administration.
- Staplin L, Lococo K, Gish K, & Decina L. 2003b, *Model Driver Screening and Evaluation Program. Final Technical Report. Volume 3: Guidelines for Motor Vehicle Administrators*. Washington D.C.: National Highway Traffic Safety Administration.
- Stutts JC & Martell C 1992, Older Driver Population and Crash Involvement Trends, 1974-1988 *Accident Analysis and Prevention*, vol. 24, pp.317-327
- Suhr J 2007, Crash raises concern about older drivers, *Wilmington Star News online*, Shiloh, Illinois. available at <http://www.starnewsonline.com/> (last accessed 17 May 2007).
- Vaillant GE & Mukamal K 2001, Successful aging, *American Journal of Psychiatry*, vol. 158, no. 6, pp. 839-47.
- Waller, J. (1992). Research and other issues concerning effects of medical conditions on elderly drivers. *Human Factors*, vol. 34, no 1, pp. 3-24.
- Woo J, Goggins W, Sham A, & Ho SC 2005, Social determinants of frailty, *Gerontology*, vol. 51, no. 6, pp. 402-8.