OLDER DRIVER’S COLLISIONS COUNTERMEASURES
NCHRP Report 500, Vol. 9

Older Drivers

• A critical subset of driver population
  – Aging affects a variety of skills
  – Physical
    • Strength, flexibility, and range of motion diminish
  – Visual abilities
    • Static visual acuity, dynamic visual acuity, contrast sensitivity, and glare sensitivity deteriorate
  – Cognitive changes
    • Working memory, selective attention, and processing speed are impaired
EXHIBIT III-1
Projected Growth in U.S. Population Age 65+

EXHIBIT III-2
Annual Crashes per 1,000 Licensed Vehicle Drivers by Age of Driver
(Source: Cornell, 1998)

EXHIBIT III-3
Crashes per Million Miles Traveled by Age of Driver
(Source: Cornell, 1998)

EXHIBIT III-4
Fatalities per 1,000 Licensed Drivers by Age of Driver
(Source: Cornell, 1998)

EXHIBIT III-5
Fatalities per 100 Million Vehicle Miles Traveled by Age of Driver
(Source: Cornell, 1998)
EXHIBIT III-6
Of People who Died in Collisions, Percentage who Died in Angle Collisions
(Source: NHTSA, 1997)

EXHIBIT III-7
Percent of Time Drivers Are at Fault when They Are Involved in a Two-Vehicle Crash (by Driver Age)
(Source: Stewart et al., 1999)
## Key Functional Abilities by Aging and their Relationship to Driving

<table>
<thead>
<tr>
<th>Vision</th>
<th>Reduced visual acuity</th>
<th>Visual acuity is used to see detail, such as road signs</th>
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<tbody>
<tr>
<td>Reduced visual contrast sensitivity</td>
<td></td>
<td>Contrast sensitivity to see targets that don't differ much in brightness or color</td>
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<tr>
<td>Increased susceptibility to glare/slower glare recovery</td>
<td></td>
<td>Older persons suffer more from glare due to vitreous changes</td>
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<thead>
<tr>
<th>Vision</th>
<th>Reduced sensitivity to changes in angular size and motion</th>
<th>Older drivers judgment of speed, rate of closure and gap</th>
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<tr>
<td>Less efficient visual search</td>
<td>Visual search abilities influence how fast a person can find and identify safety threats</td>
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<tr>
<td>Reduced area of visual attention</td>
<td>Useful field of vision shrinks with age</td>
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<tr>
<td>Cognition</td>
<td>Impaired selective attention ability</td>
<td>Drivers must filter out important events and information to select critical safety data</td>
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<tr>
<td>Less efficient divided attention and slower attention switching</td>
<td>Drivers must monitor and respond to multiple sources of information at the same time. For example, a driver entering a freeway must track ramp curvature, steer appropriately, keep a safe distance behind the car ahead, select a gap in traffic, and accelerate to enter the gap.</td>
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</tr>
<tr>
<td>Less efficient working memory processes</td>
<td>Need to recall recently learned information while driving, without lapses in safely controlling one’s vehicle</td>
<td></td>
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| Psychomotor and Physical Skills  | Loss of limb strength, flexibility, sensitivity, and/or range of motion | Need to steer, apply brakes, operate accelerator with appropriate speed control |
Objective I

Improve roadway and driving environment to accommodate older driver’s special needs

Strategy A
Provide Advance Warning Signs

• Advance warning signs should be used;
  – Where speed may have to be reduced
    • Curves, grades, bumps, dips, approaches to STOP and YIELD signs, to signal, to RR grade crossings
EXHIBIT V-4
Advance Warning Sign in Advance of a Signalized Intersection (Atlanta District, TxDOT)

EXHIBIT V-5
Advance Warning Sign in Advance of a Signalized Intersection (Atlanta District, TxDOT)
Strategy B – Provide Advance Guide Signs and Street Name Signs

- Guide signs inform driver about location and route, direct driver to destination, identify roadside services
Strategy C – Increase Size and Letter Height of Roadway Signs

- Loss in visual acuity makes it difficult to read signs
- FHWA Older Driver Handbook recommends increasing letter height by 30%
- For speeds > 35 mph, increase street name signs to
  - 8 in. lower case
  - 10 in. uppercase
Strategy D – Provide All-Red Clearance Interval at Signalized Intersections

- To calculate yellow change interval, Older Driver Handbook recommends
  - Retention of 1 sec PIEV
  - Adding an all-red clearance interval
- Signal change creates extreme processing demand for older drivers

Strategy E – Provide More Protected Left-Turn Signal Phases at High Volume Intersections

- Older drivers are over-involved in left-turn accidents at signalized intersections
  - Accident rates for elderly drivers are higher with permitted left-turn phases than protected left-turns
  - Protected left-turn phase simpler
Strategy F – Provide Offset Left-Turn Lanes at Intersections

- Sight distance for safe stopping provided by offset left-turn lanes
- Offset helps driver judge operations
Strategy G – Improve Lighting at Intersections, Horizontal Curves & RR Grade Crossings

- Roadway accidents are disproportionately higher at night
- Elderly drivers have more difficulty at night
  - Loss in visual acuity
  - Loss in contrast sensitivity
  - More light needed by elderly
- Increased lighting proven to reduce accidents
Strategy H
Improve Roadway Delineation

• Provide elderly drivers with better visual cues
• Older drivers have
  – Reduced visual acuity
  – Reduced field of view
  – Increased decision time
  – Slower response time
• Use
  – Raised pavement markers
  – Raised channelization at intersections
  – Delineators on horizontal curves

Strategy I – Replace Painted Channelization with Raised Channelization

• Raised channelization yields better contrast
• Older drivers have poor contrast sensitivity
• Left-turn channelization benefits slow accident frequency reductions

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<tr>
<th></th>
<th>Rural</th>
<th>Suburban</th>
<th>Urban</th>
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<tbody>
<tr>
<td>Painted channelization</td>
<td>50%</td>
<td>30%</td>
<td>15%</td>
</tr>
<tr>
<td>Raised channelization</td>
<td>60%</td>
<td>65%</td>
<td>70%</td>
</tr>
</tbody>
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(McFarland, 1979)
Objective II
Design geometrics to accommodate the elderly driver

New Design Driver
“Senior Citizen!”
Strategy J – Reduce Intersection Skew Angle

- Intersections with skew angle between 60-75° are undesirable
- Older drivers lose flexibility and head/neck mobility
- Restricted movement makes it difficult to
  - Judge gaps
  - Recognize conflicts
  - Analyze sight distance
Design Element: Receiving Lane (Throat) Width for Turning Operations

- Minimum Receiving Lane Width of 12 ft.

- Accompanied by a 4 ft. (1.2m) shoulder

Design Element: Channelization

- Raised channelization with sloping curbed medians is recommended over use of flush pavement marking
  - For: Left and right turn lanes operating less than 40 mph.
  - For: Right turn lanes operating ≥40 mph.

- Use sloping curbs rather than barrier curbs, except for pedestrian refuge or access control
Design Element: Right Turn Channelization

- Where right-turn channelization is used at intersection, an acceleration lane is recommended
- With right-turn channelization, an adjacent pedestrian refuge island is recommended

Design Elements: Raised Median vs. TWLTL

- Use channelized left turn lanes with continuous raised-curb median rather than TWLTL’s
  - Where ADT’s exceed 20,000
  - To improve a demonstrated crash problem
  - Based on engineering study
Raised Median vs. TWLTL: Support

- Older drivers feel TWLTL are confusing, risky, and uncomfortable
- Seeing pavement markings in poor lighting (night, fog, rain) difficult
- Older drivers do not always use TWLTL for turning, and enter TWLTL too soon
Intersection Sight Distance (ISD): Design Element

- Should provide at least $2.5^s$ perception reaction time
- Where ISD is based on “gap”, use a gap of – 8.0 sec., plus 0.5 sec. for each additional lane, for slower decision times of older drivers
Intersection Sight Distance (ISD)

- Older drivers don’t react much slower, but take significantly longer to make decisions, especially in complex conditions.
- Older drivers are affected more by short ISD, due to difficulty in head movement, longer decision time, and longer response time.
Objective III

Improve work zone design and operations for the elderly

Strategy K – Improve Traffic Control at Work Zone

- Work zones often violate driver expectancy
- Virtually all drivers are unfamiliar
- Vision and cognitive deficiencies from aging compound the problems in work zone
- Recommendations
  - Advance signing for lane closures
  - Variable message sign to better inform
  - Use clear channelization
  - Delineate crossovers
  - Remove permanent marking where not applicable; replace with temporary markings