



**AOTA Critically Appraised Topics and Papers Series**

**Driving and Community Mobility  
for Older Adults**

*\*A product of the American Occupational Therapy Association's  
Evidence-Based Literature Review Project*

**CRITICALLY APPRAISED PAPER (CAP)**

***Focused Question***

**What is the evidence for the effect of automobile-related modifications on the driving ability, performance, and safety of the older adult? Modifications include changes by the industry that enhance or hinder the driving ability, performance, and safety of the older adult.**

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Caird, J. K., Horrey, W. J., & Edwards, C. J. (2001). Effects of conformal and nonconformal vision enhancement systems on older-driver performance (Report No. 01-0479). *Transportation Research Record, 1759*, 38-45.

**PROBLEM STATEMENT (JUSTIFICATION OF THE NEED FOR THE STUDY)**

State the problem the authors are investigating in this study.

There has been research conducted that supports the possible benefits of using a vision enhancement system (VES) such as earlier perception of hazards that could cause accidents. However, reliable results supporting the usefulness of VES during adverse driving conditions (e.g., fog) are not available. Furthermore, research and evidence are needed to determine the safety and performance of these systems in simulated and real world contexts.

**RESEARCH OBJECTIVE(S)**

List study objectives.

To determine which real world objects (e.g., pedestrians, other vehicles) should be enhanced by VES displays and how these enhancements affect older and younger driver performance in important traffic contexts.

**DESIGN TYPE:**

Randomized Controlled Trial

**Level of Evidence:**

I

Limitations (appropriateness of study design):

Was the study design type appropriate for the knowledge level about this topic? *If no, explain.*

Yes

No

**SAMPLE SELECTION**

How were subjects selected to participate? Please describe.

Convenience—volunteers

**Inclusion Criteria**

- Men and women
- Young (18–32, mean age 23.5 years) and older (67–86, mean age 71.9 years)
- Valid driver’s license
- Currently driving
- Acceptable levels of visual contrast sensitivity
- Score in the normal range for the Stereo Optics sine wave contrast test

**Exclusion Criteria**

- Not currently driving
- Unacceptable levels of visual contrast sensitivity
- Below normal score on the Stereo Optics sine wave contrast test

Sample Selection Biases: *If yes, explain.*

Volunteers/Referrals

Yes  All the volunteers were active both mentally and physically and may not have represented the general population of elderly adults. However, this activity level could have occurred in the younger group as well.

No

Attention

Yes

No

Others (list and explain):

**SAMPLE CHARACTERISTICS**

N = 48

% Dropouts	None reported		
#/(%) Male	24 (12 young, 12 older)	#/(%) Female	24 (12 young, 12 older)
Ethnicity	NR		
Disease/disability diagnosis	Healthy young adults and healthy older adults		

NR = Not reported.

Check appropriate group:

<20/study group	20–50/study group ✓	51–100/study group	101–149/study group	150–200/study group
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Sample Characteristics Bias: If no, explain.

If there is more than one study group, was there a similarity between the groups?

Yes	✓ All groups had equal numbers of males and females, and young adults and older adults. All were healthy.
No	<input type="checkbox"/>

Were the reasons for the dropouts reported?

Yes	<input type="checkbox"/>
No	<input type="checkbox"/>
NR	✓ <input type="checkbox"/>

**INTERVENTION(S)**—Included are only those interventions relevant to answering the evidence-based question.

Baseline testing: All subjects completed; no VES during daytime conditions

AND

Conformal and nonconformal VES displays were used during different contexts (i.e., baseline, daytime, and fog) while simulated driving tasks were performed. There were five scenarios for each context: two light changes at an intersection, two intersections without light change, and one everyday driving scenario not defined

OR

Nonconformal visual enhancement system: Expanding blue bar placed at 1.2 degrees below the line of sight, directly in front of the driver. As the vehicle approached, the size of the bar increased. This VES does not inform the driver of the location of the object. For an approaching light, the expanding blue bar was placed on the road (traffic light being superimposed on the bar)

Baseline testing: All subjects completed; no VES during Daytime conditions

AND

Conformal and nonconformal visual enhancement system displays were used during different contexts (i.e., baseline, daytime, and fog) while simulated driving tasks were performed. There were five scenarios for each context: two light changes at an intersection, two intersections without light change, and one everyday driving scenario not defined

OR

Nonconformal visual enhancement system: Expanding blue bar placed at 1.2 degrees below the line of sight, directly in front of the driver. As the vehicle approached, the size of the bar increased. This VES does not inform the driver of the location of the object. For an approaching light, the expanding blue bar was placed on the road (traffic light being superimposed on the bar)

*Add groups if necessary*

Group 1

Brief Description	Group using the <i>Conformal visual enhancement system</i> : Displays used during different contexts (i.e., baseline, daytime, and fog); consisted of a blue horizontal bar superimposed on the front and rear bumpers. As the vehicle approaches the bar increased in size. For traffic lights, the blue bar was placed behind the light, as if it surrounded the light.
Setting	Institution, same for all subjects
Who Delivered?	Researchers who delivered the intervention were not specified
Frequency?	One session
Duration?	90 minutes

## Group 2

Brief Description	Group using the <i>Nonconformal visual enhancement system</i> displays were used during different contexts (i.e., baseline, daytime, and fog) while simulated driving tasks were performed. There were five scenarios for each context: two light changes at an intersection, two intersections w/o light change, and one everyday driving scenario not defined
Setting	Institution, same for all subjects
Who Delivered?	Researchers who delivered the intervention were not specified
Frequency?	One session
Duration?	90 minutes

### Intervention Biases: *Explain, if needed.*

#### Contamination

Yes

No

#### Co-intervention

Yes

No

#### Timing

Yes

No

#### Site

Yes

No

#### Use of different therapists to provide intervention

Yes

No

**MEASURES AND OUTCOMES**—Included are measures relevant to answering the focused question.

Name of measure:

Perception Response Time (PRT)

Outcome(s) measured (what was measured?):

Time for drivers to detect and identify the pedestrian, decide on an appropriate action, and initiate response

Is the measure reliable (as reported in article)?

Yes

No

NR

Is the measure valid (as reported in article)?

Yes

No

NR

How frequently was the measure used for each group in the study?

Frequency was not specifically reported other than during baseline, day, and fog conditions when the pedestrian crossed the street. The number of times a pedestrian crossed the street may have been once for each scenario.

Name of measure:

Response type when pedestrian appears

Outcome(s) measured (what was measured?):

Braking and/or steering

Is the measure reliable (as reported in article)?

Yes

No

NR

Is the measure valid (as reported in article)?

Yes

No

NR

How frequently was the measure used for each group in the study?

The frequency was not specified due to the uncertainty of how many pedestrians appeared during the simulation.

Name of measure:

Lateral separation distance during everyday driving

Outcome(s) measured (what was measured?):

Distance between participant's vehicle and parked and oncoming vehicle

Is the measure reliable (as reported in article)?

Yes

No

NR

Is the measure valid (as reported in article)?

Yes

No

NR

How frequently was the measure used for each group in the study?

During everyday driving, there were five parked and five approaching vehicles. Frequency was not specifically reported during baseline, day, and fog conditions during everyday driving. Ten times total for each condition?

Name of measure:

Response types during intersection

Outcome(s) measured (what was measured?):

Stopping or running the light

Is the measure reliable (as reported in article)?

Yes

No

NR

Is the measure valid (as reported in article)?

Yes

No

NR

How frequently was the measure used for each group in the study?

There were four intersection lights (2 with changing, 2 without changing) for every scenario. Number of times measured was not specifically reported, but may have been 4 per scenario.

Name of measure:

Qualitative questionnaire

Outcome(s) measured (what was measured?):

6 open-ended questions that addressed positive and negative perceptions of the VESs

Is the measure reliable (as reported in article)?

Yes

No

NR

Is the measure valid (as reported in article)?

Yes

No

NR

How frequently was the measure used for each group in the study?

One questionnaire given post VES usage

### Measurement Biases

Were the evaluators blinded to treatment status? *If no, explain.*

Yes

No

Recall or memory bias? *If yes, explain.*

Yes

No

Others (list and explain):

Limitations (appropriateness of outcomes and measures)? *If no, explain.*

Did the measures adequately measure the outcome(s)?

Yes

No

## **RESULTS**

List results of outcomes relevant to answering the focused question

Include statistical significance where appropriate ( $p < 0.05$ )

Include effect size if reported

- Day separation was significantly less than baseline and fog conditions. ( $p < 0.025$  and  $p < .037$ )
- VES type by condition interaction was significant ( $p < .015$ ) but age and gender were not.

- PRTs to the pedestrian were faster with conformal than nonconformal ( $p < .003$  and  $p < 0.002$ ).
- PRTs during fog were slower than day condition PRTs. Age and gender were not significant.
- Trends during stoplight scenario: more older drivers ran the stoplight than younger, those with conformal VESs ran the lights less than those with nonconformal. These results were trends, no significance was found
- Significance for the qualitative portion is N/A, themes were pulled from the responses.

Was this study adequately powered (large enough to show a difference)? *If no, explain.*

Yes

No  It is possible that the trend for older adults to run red lights more than younger drivers may have achieved statistical significance with a larger study sample.

Were appropriate analytic methods used? *If no, explain.*

Yes  The researchers used sophisticated statistical measures (i.e., MANOVA and post hoc analysis) to find correlations between the many variables.

No

Were statistics appropriately reported (in written or table format)? *If no, explain.*

Yes

No

## CONCLUSIONS

State the authors' conclusions that are applicable to answering the evidence-based question.

- In all driving scenarios, conformal displays had a performance advantage over nonconformal displays.
- Enhancement of parked and oncoming vehicles was of questionable usefulness even though separation was increased.
- Highlighting may be insufficient to allow a driver to identify an object and react appropriately.
- Highlighting bars may have made the tasks more difficult for the driver due to masking actual environmental cues or distracting the driver from other potential hazards.
- VESs seem to be more appropriate during hazardous conditions such as fog but not during daytime everyday driving.
- Additional processing required to perceive the object may exceed the additional detection time had the object not been highlighted.

Were the conclusions appropriate for the Study Design (Level of Evidence)? *If no, explain.*

Yes

No

Were the conclusions appropriate for the statistical results? *If no, explain.*

Yes

No

Were the conclusions appropriate given the study limitation and biases? *If no, explain.*

Yes

No

## IMPLICATIONS FOR OCCUPATIONAL THERAPY

This section provides guidance about clinical practice, program development, and other implications of the study findings as they relate to the focused question.

In consideration of the identified study limitations (threats), what are the implications of these results and conclusions for practice?

The implications for this study are extremely narrow due to the vast number of limitations within the study. The researchers found statistical significance, but did not make conclusions about possible meaning for practice. The lack of conclusions can be seen in this statement: “VESs may provide information that duplicates, replaces, enhances or is nonessential...each kind of enhancement has advantages and disadvantages...” p. 1759.

The VESs appear to need a great deal of research before they are implemented into actual driving scenarios. Their benefits right now are questionable, and these devices are not ready to be extended into practice.

This work is based on the evidence-based literature review completed by Joseph M. Pellerito, Jr, MS, OTR with contributions from Stacey Schepens, OTR.

CAP Worksheet adapted from: Critical Review Form – Quantitative Studies ©Law, M., Stewart, D., Pollack, N., Letts, L., Bosch, J., & Westmorland, M., 1998, McMaster University. Used with permission.

For more information about the Evidence-Based Literature Review Project, contact the American Occupational Therapy Association, 301-652-6611, x 2052.



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