



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.

Gish, K. W., Staplin, L., & Perel, M. (1999). Human factors issues related to use of vision enhancement systems. *Research on Intelligent Transportation Systems, Human Factors, and Advanced Traveler Information System Design and Effects*. (Transportation Research Record 1694, Paper No. 99-0737, pp. 1–9). Washington, DC: Transportation Research Board

PROBLEM STATEMENT (JUSTIFICATION OF THE NEED FOR THE STUDY)

State the problem the authors are investigating in this study.

To date there is no consensus on the net benefits of Vision Enhancement Systems (VESs) because there are certain aspects of performance and behavior that are improved and others are degraded when using VESs. Currently the effectiveness of VES as a night driving crash countermeasure cannot be determined from previous research.

State the problem the authors are investigating in this study.

Can drivers effectively share their foveal vision among forward detection and VES detection tasks? Do drivers compensate for a reduction in perceived risk by increasing their driving speed?

RESEARCH OBJECTIVE(S)

List study objectives.

This is a preliminary investigation of the human factors concerns associated with older and younger drivers' use of VES technology.

DESIGN TYPE:

Mixed Factors, Nonrandomized

Level of Evidence:

II

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.

Not specifically reported

Inclusion Criteria

Normal or corrected to normal visual acuity of at least 20/40

Exclusion Criteria

NR

NR = Not reported.

Sample Selection Biases: *If yes, explain.*

Volunteers/Referrals

Yes

No

NR

Attention

Yes

No

Others (list and explain):

SAMPLE CHARACTERISTICS

N younger = 4 (age 2--36); *N* older = 4 (age 56--70)

N = 8

% Dropouts

#/(%) Male

#/(%) Female

Ethnicity

Disease/disability diagnosis

Check appropriate group:

<20/study group <input checked="" type="checkbox"/>	20-50/study group <input type="checkbox"/>	51-100/study group <input type="checkbox"/>	101-149/study group <input type="checkbox"/>	150-200/study group <input type="checkbox"/>
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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 Both groups were matched in amount of participants. Both groups had normal visual acuity and contrast sensitivity. Age was the differing factor that was purposive.

No

Were the reasons for the dropouts reported?

Yes

No

NR

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

The interventions/independent variables included age (younger vs. older), display (present versus absent), target (deer, pedestrian, gray square, grating), glare (present versus absent), location (left versus right), and task (navigation versus speed monitoring).

Add groups if necessary.

Group 1

Brief Description	Group of 4 older and 4 younger participants completing a driving task
Setting	Closed airstrip roads that used to be part of an airfield
Who Delivered?	NR
Frequency?	There were a total of 32 test conditions per observer, which was a factorial combination of 2 display conditions (unaided versus aided).
Duration?	There were a total of 32 test conditions per observer, which was a factorial combination of 2 display conditions (unaided versus aided).

Intervention Biases: Explain, if needed.

Contamination

Yes

No

Co-intervention

Yes

No

Timing

Yes

No

Site

Yes

No Though there were two different routes used, the experimenters were careful to make the routes the same in visual complexity and for counterbalancing purposes they had half of the users use the VES with route 1 and half with route 2.

Use of different therapists to provide intervention

Yes

No

NR

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

Name of measure:

Methods to determine observers' detection distances

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

Detection distance was determined through the following procedure:
a. Finding the absolute distance measurement in the data file corresponding to the time code reading obtained from the videotape
b. Subtracting this value from the absolute, calibrated distance to the corresponding target

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?

Every time a target was presented to the driver

Name of measure:

Methods to determine target onset distances for aided and unaided performance

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

Estimated by reviewing the quad video recordings obtained during the experiment and using specified criteria

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?

Every time a target was presented to the driver

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.

Aided detection distances were somewhat higher than unaided detection distances but were not significant. Glare ($p < 0.0003$) and target ($p < 0.0168$) were significant, as was the display x glare interaction ($p < 0.0153$). Age x display x glare interaction was only marginally significant ($p < 0.0536$).

When evaluating the drivers' perceptions of the benefits of the VES, comments were different for younger and older participants. The younger drivers were more enthusiastic about the usefulness of the display and generally more willing to use it. Older drivers were more cautious and less positive about the benefits of the display.

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

Yes

No The results that were not significant are difficult to demonstrate differences due to the extremely small sample size ($N = 8$)

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

Yes The researchers used a repeated measures analysis to determine correlations between the variables and the outcomes

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.

The researchers specifically stated that all conclusions made were preliminary and limited to the study group involved due to the small sample size.

Since the detection performances for the deer, pedestrian, and gray square targets were not significantly different; this suggests that performance was not resolution limited. Increased system resolution should not be expected to translate into significant operational benefits especially with complex scenes due to the resolution limits of peripheral vision. Alternately, results suggest contrast-limited performance. To maximize VES effectiveness, emphasis should be placed on variables that enhance displayed contrast such as increased sensor sensitivity, increased image processing, or some combination.

With regards to older drivers, since the VES experience was brief in the study, experience with the system cannot be ruled out as a sufficient means of improving efficiency. The authors report that, in general, the older drivers were more cautious and less positive about the potential benefits of a display, and they were uncomfortable scanning down to the display. More research is necessary to determine the most appropriate system design for older drivers such as the best placement in field of view for a heads-up display (HUD).

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 Yes, the researchers did not purport to have results generalizable to the average population of drivers due to the small sample size and power of the study.

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.

Due to the small sample size of this study and limited power, the implications for practice are also limited. The information is useful as preliminary data for the effectiveness of VESs, such as the possibility that VESs with a focus of contrast enhancement are more effective than those with resolution-based focus. Also, the practitioner may want to consider that detection may be better using the VES, but should not use these results as definitive support when determining use or nonuse of a VES for a client. Finally, practitioners should keep in mind that there may be more appropriate positioning of a HUD such as frontal placement for older drivers, but more research is necessary to make any definitive decisions on this notion.

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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