



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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Burns, N. R., Nettelbeck, T., White, M., Wilson, J. (1999). Effects of car window tinting on visual performance: A comparison of elderly and young drivers. *Ergonomics*, 42(3), 428–43.

PROBLEM STATEMENT (JUSTIFICATION OF THE NEED FOR THE STUDY)

State the problem the authors are investigating in this study.

Speed of visual processing in elderly drivers is compromised under marginal viewing conditions and this effect is heightened when viewing with reduced visual light transmission (VLT).

RESEARCH OBJECTIVE(S)

List study objectives.

To determine performance of young and elderly adults on driving tasks with levels of VLT varying from 100% to 20%.

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.

Convenience—volunteers

Inclusion Criteria

- Vision
- Normal ocular physiology
- Contrast sensitivity
- Current driver's license

Exclusion Criteria

Optometric testing excluded anyone with abnormal vision.

Sample Selection Biases: *If yes, explain.*

Volunteers/Referrals

Yes

No

Attention

Yes

No

Others (list and explain):

SAMPLE CHARACTERISTICS

Experiment 1—The study contains two separate experiments.

N = 30

% Dropouts

#/(%) Male #/(%) Female

Ethnicity

Disease/disability diagnosis

Experiment 2—The study contains two separate experiments.

N = 26

% Dropouts

#/(%) Male #/(%) Female

Ethnicity

Disease/disability diagnosis

Check appropriate group:

Experiment 1

<20/study group <input checked="" type="checkbox"/>	20–50/study group	51–100/study group	101–149/study group	150–200/study group
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Experiment 2

<20/study group <input checked="" type="checkbox"/>	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

No

Were the reasons for the dropouts reported?

Yes

No

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

Add groups if necessary.

EXPERIMENT ONE

(The elderly and young groups received identical stimuli/tasks.)

Brief Description	Each trial began with the binocular presentation of a specific figure/target in the center of the visual field. The target then was replaced by a mask. The participant responded by pressing the corresponding key on a panel to indicate on which side the shorter line had appeared.
Setting	Each subject was seated before the apparatus in a small, artificially lit room, with the key panel in front. The institution where this took place was not specified.
Who Delivered?	The specific researcher who was involved with the presentation of the stimuli was not reported. The entire sequence of stimulus presentations was automated by a computer program.
Frequency?	One experimental session. Six sets of trials per six possible combinations of luminance (two levels) and VLT (three levels). There were brief rests between VLT levels in each luminance condition, and approximately five minutes between luminance conditions. Emphasis was placed on accuracy in responding as opposed to speed in responding, so each subject's session duration varied.
Duration?	The one experimental session was completed within one day.

EXPERIMENT TWO

Brief Description	Two levels of target contrast were used: high and low simulating headlight illumination availability or no headlight illumination availability. Three levels of VLT were used: no window, light body-tint, and a film producing 35% VLT. In addition to the inspection time (IT) task in experiment one, a second backward masking task was used, involving recognition of alphanumeric characters. Within a session, there were six experimental conditions corresponding to two levels of target contrast (high versus low) and three levels of tinting (100, 81.3, and 35.1% VLT). The subjects responded verbally to the IT tasks or alphanumeric tasks and the experimenter pressed the corresponding button on the response board.
Setting	Each subject was seated in a small, artificially dimly lit room, with the computer monitor in front. The institution where this took place was not specified.
Who Delivered?	The experimenter was not specified.
Frequency?	Two experimental sessions took place. At one session conditions involving the IT task were completed, and at the other, conditions involving the alphanumeric task. The length of the individual session was not specified.
Duration?	Duration of these sessions was not specified.

Intervention Biases: Explain, if needed.

Contamination

Yes

No All groups in both experiments received the same stimuli.

Co-intervention

Yes

No

Timing

Yes

No

Site

Yes

No All tasks took place within the same laboratory.

Use of different therapists to provide intervention

Yes

No

NR

NR = Not reported.

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

Name of measure:

Inspection Time (IT) Task

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

IT for elderly and young adults in various viewing conditions (high and low luminance)

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?

Six sets of trials were conducted, each including a measurement of the inspection time per subject. Participants were randomly allocated to one of four possible orders for completing the six conditions, thereby controlling for an additional practice effects.

Measurement Biases

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

Yes

No Not required—the measurements obtained were objective and quantitative data

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

Name of measure:

Inspection Time (IT) Task

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

The inspection time for two pattern-masking tasks within three different levels of visible light transmittance and two levels of target contrast

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 two experimental sessions dividing up the two pattern-masking tasks. Within each session the IT was measured six times, corresponding to the six experimental conditions.

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.

- Significant three-way interaction between age group, luminance level, and VLT level ($p < 0.01$).
- No difference was apparent for the groups in the high-luminance condition, but the young and elderly exhibited different patterns of linearity in the low-luminance condition ($p < 0.01$).
- Mean IT was longer for the low-luminance condition irrespective of the VLT level, and this effect was greater for the elderly ($p < 0.01$).
- Mean IT was longer for the elderly group in each condition ($p < 0.01$).

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

Yes

No

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

Yes

No

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

Yes

No

List results of outcomes relevant to answering the focused question.

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

Include effect size if reported.

- Three-way interaction between age group, target contrast, and VLT level was not significant ($p = 0.21$), appearing to be due to the great variability in performance on the IT task by the elderly participants.
- Elderly participants had longer IT estimates than the young ($p < 0.05$).
- Interaction between target contrast and age group was significant ($p < 0.05$).

- Little difference between the IT estimates for the 100 and 81.3% VLT conditions in either contrast condition for either age group, as expected ($p = 0.41$).
- Interaction between age group and the effect of contrast and the effect of 35.1% VLT was significant ($p < 0.05$).
- Interaction between target contrast effect, the effect of 35.1% VLT, and age group was not significant ($p = 0.19$).

Alphanumeric Task:

- Elderly participants had longer CSOA estimates than the young ($p < 0.05$).
- Significant difference between the 100 and 81.3% VLT conditions ($p < 0.05$), possibly reflecting the practice effect.
- Interaction between target contrast and age group was not significant ($p = 0.06$).
- Interaction between age group and the effect of 35.1% VLT was significant ($p < 0.05$).

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

Yes

No

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

Yes

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.

EXPERIMENT ONE

Findings support the claim that tinting of car windows will not affect driver performance when viewing conditions for the elderly groups are optimal. However, under marginal viewing conditions, elderly drivers were affected by VLT levels as high as 63% and performance deteriorated as VLT decreased. Young adults also showed a deterioration in performance as VLT decreased from 63 TO 20%.

EXPERIMENT TWO

For the IT task, a decrement in performance for the elderly was not consistent across participants. Those with longer IT estimates in optimal viewing conditions showed greatest decrement in performance for the worst viewing conditions. Findings imply that not all elderly drivers will be affected to the same extent by decreased VLT levels.

An implication from the alphanumeric test is that the use of windows carrying a light body tint poses no increased risk of road accidents even in marginal viewing conditions. The elderly are detrimentally affected by reduction in VLT level to 35%. For conditions most likely to apply when viewing through front side windows of a car at nighttime, the elderly are compromised in their ability to scan the road adequately.

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.

IT tasks may have shown some ecological validity in assessing the effects of reduced VLT on elderly drivers. An empirical study in the field may be required to provide definitive evidence on the effects found in the experiment. A conclusion was drawn that the level of tinting for front side windows should not be reduced to 35% VLT. Results found in this experiment show that a more conservative level equal to that for the primary vision area (PVA) of the windshield poses no increased risk of road crashes due to decrement in visual performance.

These study results are beneficial to occupational therapists, especially those who are involved in driver rehabilitation. The occupational therapist should consider what level of tinting is safe and recommend that level for a client's car, especially for elderly clients. During actual driving assessments, occupational therapists should be aware of the potential hazards that tinted windows pose to clients during various times of the day and night, and use that information to recommend safer driving habits such as daytime driving only.

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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