



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.

Imbeau, D., Wierwille, W. W., Wolf, L. D., & Chun, G. A. (1989). Effects of instrument panel luminance and chromaticity on reading performance and preference in simulated driving. *Human Factors*, 31(2), 147–160.

PROBLEM STATEMENT (JUSTIFICATION OF THE NEED FOR THE STUDY)

State the problem the authors are investigating in this study.

Standard dashboard instrumentations have yet to be definitively investigated and resolved: namely, which color should be used to illuminate the panel for night driving? Few studies that have been conducted are performed in realistic driving situations.

RESEARCH OBJECTIVE(S)

List study objectives.

Determine more precisely which of the instrument panel illumination colors, brightness, and character sizes are most suitable for night driving based on performance and subjective measures in a combination of driving and legend-reading tasks.

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

- Valid Virginia driver’s license
- Minimum of 20/40 static visual acuity
- Normal color vision

Exclusion Criteria

NR

NR = Not reported.

Sample Selection Biases: *If yes, explain.*

Volunteers/Referrals

Yes

No

Attention

Yes

No

Others (list and explain):

SAMPLE CHARACTERISTICS

N = 24

% Dropouts

#/(%) Male

#/(%) Female

Ethnicity

Disease/disability diagnosis

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

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.

Group 1

Brief Description	Groups were divided only by age as described above. All groups received all the interventions.
Setting	Vehicle Analysis and Simulation Laboratory at Virginia Polytechnic Institute and State University
Who Delivered?	Experimenters at simulation laboratory
Frequency?	Once
Duration?	Length of experiment

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

NR

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

Name of measure:

Response time to a stimulus presentation to a correct answer measured by a voice-operated logic signal interfaced with the computer for the projectors

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

Time elapsed from presentation of the stimulus until the moment at which the subject vocalized a 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?

During all 16 series of words

Name of measure:

Time glancing measured by the experimenter after viewing a low-light videotape camera mounted to observe the subject's face; experimenter depressed a push button when the subject glanced and held it until the subject's eyes returned to driving

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

Glance time was the total time the subject looked at the stimulus prior to a vocal answer; time glancing at the display regardless of correctness

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 all 16 series of words

Name of measure:

Percentage of correct answers only (out of 4 replications)

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

See above

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 all 16 series of words

Name of measure:

Percentage of correct and incorrect answers out of 4 replications; failure to respond was not counted as an incorrect answer

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

See above

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 all 16 series of words

Name of measure:

Lane deviation measured by a microcomputer interfaced with the simulator

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

Variance of lane deviation regardless of correctness

Is the measure reliable (as reported in article)?

Yes

No

NR

Is the measure valid (as reported in article)?

Yes

No

NR The authors stated that this measure is sensitive to lateral movements within the lane but is not affected by absolute position in the lane

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

During all 16 series of words

Name of measure:

Subjective view on a 7-point Likert scale

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

Attractiveness, comfort, ease of reading

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?

Taken at the end of each series of words

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.

Preliminary Experiment

Older subjects selected higher luminance levels than younger subjects ($p < .005$). Chromaticities in the longer wavelengths that had the highest excitation purities had fairly high luminance values in the high-brightness condition.

Main experiment: objective measures

All main effects except gender were significant at the .05 alpha level. Character size x chromaticity x brightness interaction was significant in 3 measures: response time and accuracy measures. Accuracy appeared to be dependent on chromaticity and brightness for the 2 smaller character sizes. Chromaticity had a statistically significant effect on accuracy with the 7-arcmin size at low brightness levels only, and the effect on response time was significant with the 7-arcmin size at both brightness levels as well as with the 11-arcmin size at low brightness. Performance correlated best with luminance in the conditions involving smaller character sizes at low brightness. None of the interactions simultaneously involving age and chromaticity was significant. Brightness x character size x age interaction was significant for all 5 measures. Accuracy was degraded with the 2 smaller character sizes for older subjects, whereas the middle-aged drivers showed degraded performance only with the smallest character size. Performance with the 2 larger character sizes was equivalent in all groups except for the 17-arcmin size at low brightness, for which older drivers had significantly longer glance and response times.

The word complexity main effect was significant for both response and glance time measures but not a significant effect on accuracy or driving behavior.

Main experiment subjective measures

Brightness and chromaticity had significance. Blue was the least attractive; red, blue green, and green had neutral ratings; and orange, reddish orange, white, and amber were most attractive. Comfort failed to reveal significant differences among chromaticities. None of the interactions involving age was significant for attractiveness and comfort. With ease of reading, chromaticity, character size, and brightness were significant ($p < .05$) as well as chromaticity x character size and brightness x character size interactions.

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.

The smallest character size (7 arcmin) should not be used because it was difficult for older drivers to read and leads to decrements in driving and word recognition. The 11 arcmin was good for younger and middle aged drivers but older drivers still had significant degradation of driving. Preference should be given to the 25 arcmin but the 17 arcmin should also be considered acceptable if adequate luminance is available. No chromaticity needs to be disqualified for the 2 larger character sizes at 2 brightness levels with respect to performance. The driver should be able to set the brightness level at will, and adequate luminance ranges should be available. When the driver is placed in a stressful situation, performance decrements will occur with longer or unusual words.

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.

For drivers with special needs (e.g., older drivers), practitioners should carefully consider what type of dashboard display that client has. Elderly drivers' performance is best with a 25 arcmin and thus that display should be a recommendation by practitioners if the client has a choice when selecting a car. As for general recommendations for the average adult, the 25 arcmin is also optimal. According to the results, practitioners generally need not worry about the chromaticity of the display. Since brightness level opinions vary for different aged populations, practitioners should recommend a car that has adjustable brightness levels for best comfort and driving performance.

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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