



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.

De Waard, D., van der Hulst, M., Brookhuis, K. A. (1999). Elderly and young drivers' reaction to an in-car enforcement and tutoring system. *Applied Ergonomics*, 30, 147–157.

PROBLEM STATEMENT (JUSTIFICATION OF THE NEED FOR THE STUDY)

State the problem the authors are investigating in this study.

The violation of at least one traffic law precedes 92% of accidents. Preventing drivers from making violations can be expected to have a considerable positive effect on road traffic safety. Human factors and potential safety effects of a driving offence detection system need to be explored.

RESEARCH OBJECTIVE(S)

List study objectives.

To determine whether or not a driving offence detection system is effective in changing law-abiding behavior, and whether after introduction any secondary effects of the system can be expected. The effects of this system on mental workload and also the acceptance of such a tutoring system were studied.

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 or corrected to normal
- Of legal age to drive

Exclusion Criteria

Experiences simulator sickness

Sample Selection Biases: *If yes, explain.*

Volunteers/Referrals

Yes

No

NR

Attention

Yes

No

Others (list and explain):

NR = Not reported.

SAMPLE CHARACTERISTICS

N = 37

Final count: 18 young (aged 30–45), 18 elderly (60–75)

% Dropouts

#/(%) Male

#/(%) Female

Ethnicity

Disease/disability diagnosis

Check appropriate group:

<20/study group	20–50/study group <input checked="" type="checkbox"/>	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.

Intervention included use of a Detection, Enforcement, and Tutoring for Error Reduction (DETER) system while subjects performed two sessions (2nd and 3rd trials) with feedback about violations in auditory or visual form (modalities were balanced across subjects). First and the fourth trials had no feedback. Age was also an independent variable during the task.

Add groups if necessary

Group 1

Brief Description	Groups were divided by age as described above and received all interventions listed
Setting	Driving simulator modified BMW 518
Who Delivered?	NR
Frequency?	The first visit included filling out questionnaires and performing a trail-making test (time/length NR). The second visit involved the 4 test rides about 15 minutes each.
Duration?	The first visit included filling out questionnaires and performing a trail-making test (time/length NR). The second visit involved the 4 test rides of about 15 minutes each.

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:

Effectiveness of the System

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

Changes in driver behavior: speeding, not coming to a stop before a stop sign, red light running, and entrance of a one-way road from the wrong direction (level of speeding, number of warnings, and minimum stop speed were also registered).

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 testing sessions 1 and 4 only

Name of measure:

Performance on Driving Task

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

Measure of control over the vehicle's lateral position, measured as SD of the lateral position

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?

NR

Name of measure:

Mental workload using the Rating Scale Mental Effort and heart rate/energy

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

Determined by self-reports and analysis of the driver's physiological state (heart rate and energy)

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?

Self-reports were collected after every testing session. Heart rates were determined as baseline during the 3 minutes between the first and second session as well as after completion of all testing.

Name of measure:

Acceptance of and Opinions about the Tutoring System

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

Questionnaire about acceptance of the tutoring system

Is the measure reliable (as reported in article)?

Yes A citation was made that may speak to the level of the questionnaire's reliability

No

NR

Is the measure valid (as reported in article)?

Yes A citation was made that may speak to the level of the questionnaire's validity

No

NR

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

Before testing and after completion of all testing

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.

Effect of warnings on violations

The auditory and visual tutoring messages clearly reduced the number of violations made during sessions 2 and 3. During the last session, the younger participants returned to their baseline (session 1) but the elderly continued to have fewer violations, with a ($p < .05$) difference between the ages. The amount and degree of speed violations decreased from session 1 to 3 for both groups and continued to decrease for elderly in session 4 ($p < .01$). The number of stop violations decreased from sessions 2 and 3. Red light running decreased during the tutoring sessions and slightly increased during session 4.

Effect on task performance and workload

Standard deviation of lateral position increased over time ($p < .01$). There was a trend toward the tutoring device affecting the performance ($p < .06$). No group differences were found on average or SD of the lateral position. The tutoring sessions were more demanding than the nontutoring sessions ($p < .05$). Invested effort did not differ between the groups. Heart rates differed on all parameters of the task as compared to the rest measurements (HR ($p < .01$); heart rate variability ($p < .05$); Hz component ($p < .1$). No effects of group on the heart HRV were found.

Effects of tutoring modality

There were no significant differences between tutoring modalities, nor were there significant effects on mental effort.

Acceptance

Elderly drivers expected a useful system and this opinion was strengthened after exposure, while younger drivers did not alter their positive opinion on usefulness ($p < .01$). Regarding satisfaction, elderly drivers had an increasingly positive opinion and younger drivers had a more negative attitude after the test ($p < .01$).

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

Yes

No small sample size

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 tutoring system was successful in increasing law-abiding behaviors during driving. Drivers were safer in complex situations when receiving tutoring. Tutoring leads to reduced driving speed and improved stop behavior, and these effects contribute to traffic safety. Possibly as a side effect of the increased mental effort, primary task performance as reflected in the SD of the lateral position improved under the tutoring conditions. Though modalities had equal effects, auditory systems may be preferred. Elderly drivers were more accepting of the technology after use. Elderly drivers may have made violations due to unawareness and then welcomed the tutoring for awareness, unlike the younger drivers. Overall, continuous monitoring of driver behavior seems to be an effective way to increase law compliance.

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 The only conclusion that was not appropriate was saying that auditory feedback systems versus the visual systems may be more beneficial, when the evidence does not support this statement.

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.

This study reveals to practitioners that tutoring systems can indeed improve safe driving behaviors and decrease law violations. This appears to be particularly useful for elderly clients who tend to violate the law due to unawareness. This system did not, however, prove to be useful for increasing driving performance. If a client has displayed unsafe driving behaviors resulting from law violations, and if his or her goal is to increase safe and independent driving, tutoring systems may be a beneficial intervention. Though the authors of this study still recommended auditory modalities even after no significant differences were found between visual and auditory feedback, practitioners should be cautious in taking this recommendation without supportive evidence from this study.

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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