



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 modifications of the infrastructure of the physical environment (e.g., roadways, signage, and lighting) on the driving ability, performance, and safety of the older adult?

Ho, G., Scialfa, C. T., Caird, J. K., & Graw, T. (2001). Visual search for traffic signs: The effects of clutter, luminance, and aging. *Human Factors*, 43, 194–207.

PROBLEM STATEMENT (JUSTIFICATION OF THE NEED FOR THE STUDY)

State the problem the authors are investigating in this study.

Authors claim prior research suggests that older drivers would have greater problems than younger drivers in (1) finding and (2) understanding traffic signs. [Comment: It is true that older drivers are likely to have poorer vision than younger drivers, and consequently may be slower in finding traffic signs. However, the leap from evidence that the *elderly* may have problems with working memory and attention, to the suggestion that *older* drivers may have more problems in acquiring the information presented on traffic signs is dubious at best; the 12 “older” drivers who participated in the study had an average age of 64.71 and the age range was from 56 to 71—few, if any of these 12 are likely to be considered *elderly*.]

RESEARCH OBJECTIVE(S)

List study objectives.

The authors examine the effects of age, clutter, and scene luminance on the acquisition of traffic signs. The results of such a study could produce baseline information against which the effects of modifications to the infrastructure (e.g., roadways, signage, and lighting) could be compared.

DESIGN TYPE:

Randomized controlled trial

Level of Evidence:

Level I

Limitations (appropriateness of study design):

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

Yes

No Images were presented on a computer screen and were static. On each trial, a subject was asked to find a particular traffic sign. The finding that these traffic signs are harder to find in static images in which there was “high clutter” than they are in images in which there was “low clutter” is to be expected. However, the task presented to the participants is very different from the task of noticing traffic signs while driving. When a driver is (1) carrying out the primary task of driving; (2) moving through a three-dimensional environment (which, on the one hand, may make traffic signs easier to distinguish from “clutter,” and on the other hand, may increase the amount of clutter); (3) usually not looking for a particular traffic sign that may or may not be present—and likely will not attend to all the traffic signs that are on his or her route; and (4) does not have unlimited time (because he or she is traveling through the environment). Consequently, without some validation, this methodology will remain very limited in its applicability to real world driving situations.

SAMPLE SELECTION

How were subjects selected to participate? Please describe.

Convenience—volunteers

Inclusion Criteria

- In Experiment #1, there were 28 participants. All had been driving for at least 2 years. There were 14 in Older Group, with mean age of 64.71 (range was from 56 to 71). There were 14 in Younger Group, with mean age of 23.43 (range was from 20 to 27).
- In Experiment #2, there were also 28 participants. [It is likely that the participants in this experiment had not taken part in Experiment #1—although the authors do not state this.] All had been driving for at least 2 years. There were 14 in Older Group, with mean age of 64.3.93 (range was from 54 to 79). There were 14 in Younger Group, with mean age of 24.07 (range was from 18 to 30).

Exclusion Criteria

NR

NR = Not reported.

Sample Selection Biases: If yes, explain.

Volunteers/Referrals

Yes

✓ In Experiment #1, the 14 participants in the Older Group were “volunteers from the community.” The 14 in Younger Group were “undergraduate students.” No information is given about how the participants in either group were recruited.

In Experiment #2, the 14 participants in the Older Group were “volunteers from the community,” who responded to advertisements “placed around the university campus and in community newspapers.” The 14 in Younger Group were “volunteers from the university”—no information is given about how they were recruited.

No

Attention

Yes

✓ In Experiment #1, participants were shown examples of what the authors suggested were images with “High” and “Low” clutter. Participants were then asked to assign a number of images to “High” and “Low” clutter categories.

In Experiment #2, before each trial participants were shown an example of a traffic signs that would be the target in the test image, then were asked whether or not that target was present or absent in the test image.

No

Others (list and explain):

SAMPLE CHARACTERISTICS

N = 28 in both Experiment #1 & Experiment #2.

% 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 In both Experiment #1 & Experiment #2 there were 2 groups of participants—a Younger Group and an Older Group. The 2 groups appear to have been recruited in different ways—they were not matched in terms of abilities

Were the reasons for the dropouts reported?

Yes

No

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

Experiment #1—Images were photographs of traffic scenes taken in Calgary, Alberta. They were pre-judged by authors as “Low” clutter (with target traffic sign and “no more than one” other traffic sign in view) and “High” clutter (with several objects including other traffic signs and vehicles in view). Daytime photographs were “manipulated” by professional computer graphics illustrator to simulate nighttime luminance conditions. On the basis of the participants judgments a subset of “High” and “Low” clutter daytime and simulated nighttime images were selected.

The selected “High” and “Low” clutter daytime and simulated nighttime images from Experiment #1 were presented to the participants in Experiment #2. Some of these images contained the traffic sign each subject was shown before each presentation; and some images did not contain the traffic sign shown before each presentation. The subject’s task was to say whether or not the target sign was present or absent. Before the experiment the subjects were trained to criterion (90% correct)—with feedback as to whether or not they were correct given after each training trial.

Design:

Daytime versus Nighttime images

“High” clutter versus “Low” clutter images

Older versus Younger participants

Add groups if necessary.

Group 1

Brief Description	
Setting	
Who Delivered?	
Frequency?	
Duration?	

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:

Experiment #2—Error rate

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

Whether or not participants correctly detected the presence or absence of a target traffic sign.

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 measure was used for each participant.

Name of measure:

Reaction time

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

Time taken to decide presence/absence of target traffic sign.

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?

It was measured for each participant.

Name of measure:

Fixation Number

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

Number of eye fixations counted

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?

It was measured for each participant

Name of measure:

Last Fixation Duration

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

The duration of the final fixation

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 measure was used for each participant

Name of measure:

Average Fixation Duration

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

Average Fixation Duration

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 measure was used for each participant.

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.

Error Rate—

1. Older participants were less accurate than younger participants ($p = 0.021$).
2. Errors were more common in high-clutter trials than low-clutter trials ($p < 0.001$).
3. Errors were more common in target-present trials than target absent trials ($p = 0.02$).
4. There were also a number of significant interactions—Clutter x Presence ($p = 0.015$), with more errors made on target-present trials with high clutter; Luminance x Presence ($p = 0.025$), with accuracy for daylight conditions independent of target presence or absence, while for nighttime scenes more errors were made on target-present trials than target-absent trials; Clutter x Luminance ($p = 0.03$), with errors more common in high clutter in daylight conditions than in low clutter, while there was no consistent effect of clutter in nighttime conditions; and Clutter x Presence x Luminance ($p = 0.003$), with relatively high error rates in 3 of 4 high-clutter conditions, but the lowest error rates of any conditions for nighttime target absent trials.

Reaction Time—

1. Older participants were slower than younger participants ($p < 0.001$).
2. Participants were slower in high-clutter trials than low-clutter trials ($p < 0.001$).
3. Participants were slower in target-present trials than target-absent trials ($p < 0.001$).
4. There were also a number of significant interactions, including the complex 4-way interaction between Age x Clutter x Luminance x Target Presence interaction ($p = 0.03$).

Fixation Number—

1. As authors point out, fixation duration is strongly correlated with reaction time, and results mirror reaction time results—there were more fixations for older participants than younger ($p < 0.001$); more fixations with high clutter than with low clutter ($p < 0.001$); and more fixations for target-absent trials than target-present trials ($p < 0.001$).

Last Fixation Duration—

1. The duration of the final fixation was longer for target-present trials than for target-absent trials ($p < 0.001$).
2. There was a significant Age x Presence interaction ($p = 0.007$)—older participants had longer final fixation than the younger participants for the target-present trials; there were no age differences for the target-absent.

Average Fixation Duration—

1. Younger participants had shorter average fixation durations than older participants ($p = .003$).
2. Age x Clutter interaction ($p = 0.025$)—there were shorter average fixation durations for low clutter trials than for high clutter trials for the younger participants, while there was no difference related to clutter for the older participants.
3. A significant Clutter x Presence x Luminance interaction ($p = 0.005$) occurred because high-clutter, target-present trials had longer average fixation durations under nighttime conditions than they did under daytime conditions.

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.

Authors suggest that the effects they found with static imagery and search durations limited by the participants will be optimistic relative to dynamic real world situations.

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

As mentioned earlier, the authors presented static images on a computer screen. Then in each trial, they asked each participant to find a particular traffic sign. The finding that these traffic signs are harder to find in static images in which there was “high clutter” than they are in images in which there was “low clutter” is to be expected. However, the task presented to the participants is very different from the task of noticing traffic signs while driving, when a driver is (1) carrying out the primary task of driving; (2) moving through a three-dimensional environment (which, on the one hand, may make traffic signs easier to distinguish from “clutter,” and on the other hand, may increase the amount of clutter); (3) is usually not looking for a particular traffic sign that may or may not be present—and likely will not attend to all the traffic signs that are on his or her route; and (4) does not have unlimited time (because he or she is traveling through the environment). Consequently, without some validation, this methodology will remain very limited in its applicability to real-world driving situations.

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.

As mentioned above, without validation, this methodology will remain very limited in its applicability to real-world driving situations.

This work is based on the evidence-based literature review completed by Paula C. Bohr, Ph.D., OTR/L, FAOTA and Kathleen A. Harder, PhD.

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