

## STAYING ORIENTED WHILE DRIVING

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Do elderly drivers have more trouble finding their way and staying spatially oriented than younger drivers do? If spatial orientation is more difficult for elderly drivers it could distract attention from vehicle control resulting in a higher accident rate for elderly drivers. Moreover, it could become less desirable for older drivers to explore unfamiliar surroundings and as such diminish their action radius. In order to test our hypothesis that elderly drivers have more problems with wayfinding and spatial orientation drivers in two age groups were asked to perform a wayfinding task in an unfamiliar environment. Errors in orientation were measured and compared between age-groups. Results on this driving and wayfinding task support the original hypothesis that acquiring and maintaining spatial orientation is significantly more problematic for elderly than younger drivers, hence could be a distracting factor for vehicle control.

### INTRODUCTION

Driving is a complex dynamic task and can become even more complex when driving to an unfamiliar destination along an unfamiliar route. Under these conditions drivers need to divide their attention between the complex task of controlling their vehicle and perhaps the even more complex task of navigating. Considerable research (e.g. Salthouse, 1995; Kramer & Larish, 1996) indicates that dividing one's attention between different tasks becomes more difficult with age. There is some evidence that spatial orientation itself differs as a function of age (Ohta, 1983) Thus, driving while navigating may also become more difficult, and therefore stressful and unpleasant with increasing age. It is not known however, whether navigating while driving and maintaining spatial orientation itself differs as a function of age. Some qualitative evidence exists that elderly individuals may have problems with wayfinding while driving. Burns (1998), refers to the interviews done on collision experiences by Rothe, Cooper & de Vries, (1990), where elderly drivers express relatively often that they were searching for certain streets, road signs, or addresses when the crash investigated occurred. For this reason we investigated whether elderly drivers have more difficulty with orientation and navigation than younger drivers. We asked younger and elderly drivers to navigate through an unfamiliar environment: a real residential neighborhood, and measured their ability to stay oriented. How was orientation assessed? Our procedure was to teach participants a route around this novel environment. Then we determined how well they knew the directions of specific learned locations from certain (station-) points.

### METHOD

#### Participants

Thirty men and women participated in the driving and navigation task. Twelve participants were older than 60 (average age = 71.3), eighteen participants were between 24 and 40 (average age = 27.4). All participants drove on average at least once a week and had a valid driver's license. The volunteers were paid for their participation and the rules and regulations of the Human Subjects Committee were adhered to at all times.

#### Experimental procedure

Participants were asked to drive a route by following directions given by the experimenter seated next to the participant. Participants were asked to drive toward the starting point of the route from a meeting point at the University. This 15-minute ride assured participants were getting experience before the onset of the experiment with the situation that the experimenter was seated next to them during the experiment. The experiment took place in mornings after rush hours only. Adverse weather conditions were avoided. The participant was told that their task was: 1. To remember the route including any points of interest (landmarks) indicated by the experimenter; 2. To stay oriented toward the beginning point of the route; 3. To drive at a safe and comfortable speed; 4. To obey normal traffic rules, and 5. To be prepared to give directions for the route to the experimenter on subsequent trials. On the first trial the experimenter gave directions before each decision point and repeated the directions after the

decision point. Decision points were numbered and as such referred to (intersection 1 through 10). Points of interest (landmarks) were pointed out as the participant approached them. The experimenter would say for example: "Please notice the white church".

The participant was considered to have learned the route when he or she could traverse it making no more than one error over all decision points. Although the participant was asked to point out the landmarks and was corrected when one was missed or labeled incorrectly, the results of this part of the task were not considered when the learning of the route was evaluated. After participants reached the learning criterion of one mistake or less in relation to the decision points, they were asked to drive the route one more time. On this test trial they were asked to stop along the route twice at designated station points. For each station point they were asked to point at the various intersections and 'points of interest' (landmarks). After arriving back at the beginning point of the route participants were asked to name all street-names they could remember from the route as well as to give some insight in their strategies for the navigation and orientation task.

### Measurement tool

A large square yellow board (36.8 x 36.8 cm) with a pointer affixed in the center was used to measure pointing. Participants were asked to aim the pointer toward the designated locations and this angle was recorded by the experimenter.

### The route

The experimental route was a somewhat circular route through a residential neighborhood. Landmarks ( a bench, a brown church, a chiropractor sign, a white church, a house with pillars, a three-car garage, an athletic club and a school) were chosen in such a way that they were easily visible from the road, but not in view from the testing station points.

## RESULTS

Participants were asked to point from two station points to all intersections as well as to the various landmarks, resulting in 19 data points per participant per station point with a total of 38 data points per participant. The absolute pointing error in degrees was calculated for each data-point by subtracting the correct angle from the station point to the intersection or landmark from the pointing angle indicated by the participant.

Results from this experiment indicate a significant difference in performance on all measurements as a function of age group. Independent-samples t-tests were performed. Elderly participants made significantly larger errors than younger participants in pointing toward the intersections as well as when pointing to the landmarks from both station

points ( $p < .001$ ). Figure 1 shows the average error in degrees per age-group for the intersections as well as the landmarks.

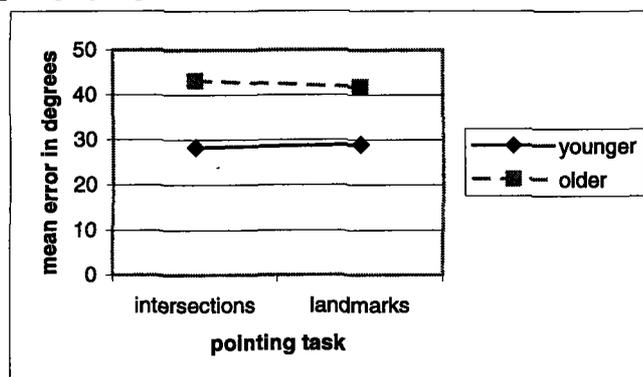


Figure 1: Mean errors in degrees for younger and elderly drivers in pointing toward intersections and landmarks in a real environment.

Aside from the questions asked to the participants at the end of the driving task, a questionnaire was filled in by 153 people (61 men and 92 women) over three different age-groups [(21-40 years old, average age=30) (41-59 years old, average age=50.5) (60-88 years old, average age=71.3)]. This questionnaire consisted of questions on demographics, driving style and habits and specific questions on how people prepare for an unfamiliar trip or what they do when they get lost.

The results of this questionnaire were consistent with other findings in the research literature and are not "surprising" in that sense. The drivers in the older age group report being more careful on the average and indicate sensitivity to driving conditions, e.g. report a preference for not driving in adverse weather conditions or unfamiliar environments. We had expected however to find specific differences between age groups with respect to reported way finding and orientation strategies and problems but this was not the case.

Elderly drivers did not report any specific problems in the area of way finding and orientation in our questionnaire. Results on the actual driving task, however, support the original hypothesis that acquiring and maintaining spatial orientation is more problematic for elderly than younger drivers. The combination of these results suggest that elderly drivers may not be aware of the fact that their ability of staying oriented in an unfamiliar environment is not as good as that of younger drivers.

Obviously a real driving task can give rise to complications beyond experimental control. Although we were very careful in making sure we avoided adverse traffic conditions as well as rush hour, you can't control it all. In order to avoid variation from above mentioned factors we designed a simulator task that was very similar to the real world driving task using the same procedure as well as measurement tool. The lay-out of the route was very similar except that it consisted of only straight roads with named

street intersections and no landmarks. Results of this experiment were the same as the results in the real world driving task (See Figure 2). Elderly drivers made significantly larger errors ( $p < .01$ ) than younger drivers in pointing to the different decision points (intersections) along the newly learned route from two different measure points.

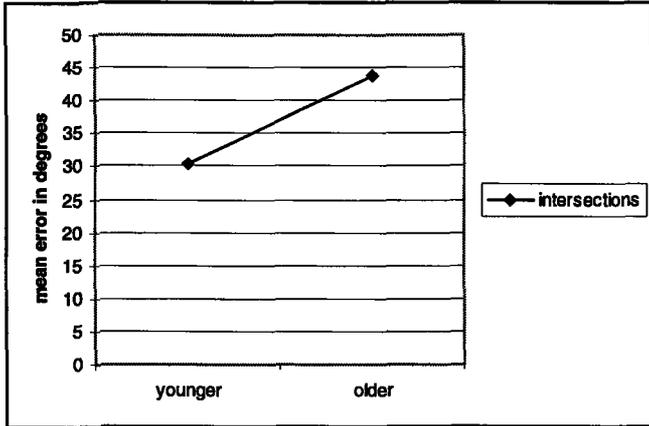


Figure 2: Mean errors in degrees for younger and elderly drivers in pointing toward intersections in a simulated environment.

## DISCUSSION

The similarity in results for the two driving tasks in the real and simulated world as discussed, is important because it suggests the validity of simulated driving for the study of these kinds of orientation problems. Moreover, in a simulator a variety of variables can be manipulated which would be difficult or impossible in a real driving situation.

Our results so far suggest it might be valuable to assist elderly drivers in their way-finding tasks in order to enable them to focus on the task of driving itself. Support can be given in designing navigation tools that fit the needs of the elderly drivers and lower the "load" on attention while driving instead of adding extra workload due to a navigation tool that is well intended yet badly designed. In general we would like to emphasize the added advantage of looking at driving as a task that in itself need not be negatively effected by the processes related to aging. However, increasing the workload by adding tasks such as wayfinding may cause driving to deteriorate. Some ongoing research is conducted on how vehicle operation is affected by a simultaneous wayfinding task.

We would like to conclude with the following general notion: In an age where more and more "helpful" high tech features in cars are added, it seems of particular importance to include concerns related to elderly drivers and possible difficulties with divided attention and dual tasks in the evaluation of such features.

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