Reported driving, self-appraisal and simulator performance in older and younger drivers

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Abstract

A group of 20 students (mean age = 26 yr.) and 19 members of a senior citizens center (mean age = 76 yr.) gave self-ratings on their performance in specific driving situations and what types of driving they do (Driver Self Report, DSR). They also performed the Elemental Driving Simulator (EDS), which includes self-appraisals and performance measures of six global aspects of driving. All the students and 17 of the seniors completed the EDS, although the seniors opted for two to three times as much practice. This completion rate compares favorably to previous EDS studies of older drivers. On the EDS the seniors rated their abilities as slightly above average, with ratings that were even higher than the self-ratings offered by the EDS published norms (mean age = 37 yr.). On all performance scales the seniors did significantly worse than the students, whose self-appraisal and ratings replicated the EDS norms'. EDS self-appraisal ratings did not correlate with EDS performance. However, on the DSR, with its more behaviorally oriented items, the seniors did give themselves lower ratings, and the DSR ratings correlated significantly ($\underline{r}$ = .69) with overall EDS performance. While older drivers may overestimate their abilities, they apparently make decisions to limit when and where they will drive that are consistent with their reduced performance on the driving simulator.

Key words: Driving, Elderly, Assessment, Counseling

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Introduction

In much of the United States and many other developed countries, driving is regarded as the key to personal mobility and essential to the conduct of one's occupation, both literally and figuratively. Mobility needs and desires continue following retirement from formal work and the alternatives to driving are often inadequate. Eventually, infirmity and adverse cognitive changes may effect the ability to drive safely. Individuals vary in this regard and although public opinion holds that there is an older driver problem, many older drivers maintain their capabilities and continue to drive. Typically, they limit their driving and as a group, their annual crash rates do not rise excessively until they reach the "old-old" (late seventies and eighties) category (Waller, 1991). Informative pamphlets by the AARP (American Association of Retired Persons, 1992) and the AAA Foundation for Traffic Safety (Malfetti et al., 1991; Malfetti et al., 1992), along with the mature driver classes, such as the 55 Alive program, offer these drivers general information. It is often difficult for seniors to withdraw from driving and families are frequently torn apart by the issue, as illustrated in this Ann Landers letter:

DEAR ANN: My father, now in his 80s, was never a good driver. Many family members refuse to go anywhere with my folks if Dad insists on driving.

Over the years, Dad's driving has become progressively worse. At least once a year ...

Ms Landers begins her reply: "Not a day goes by that I don't hear from an anxious [family member] who is worried sick about an older family member or friend who is a terrible driver." She rues the fact that retesting is not mandatory for older drivers and goes on to suggest "a request for retesting ... by court order or by the driver's physician...."

We would have to agree with Ms. Landers that there is a need, on the one hand, for assessment procedures to help identify those seniors whose crash risk has become excessive. However, we would suggest that such assessment be made available to at-risk drivers in the context of advisement or counseling. It is essential to understand the older driver's vigorous assertion of competency by which they justify continuing to drive. Focus group research by Kathy Freund offers some insights (1992) into their at times tenacious insistence on retaining the keys.. Experience in driver rehabilitation suggests also that far more than mobility is at stake for many drivers.

For example, since few drivers are either sociopathic or suicidal, it must be that they do not recognize their limits or the implications of these limits for safe driving (Irwin, 1989). Glare sensitivity, which is readily recognized and acknowledged as incompatible with safe driving, impels people to seek help from their eye doctors and causes most older people eventually to cease night driving. Because other kinds of limitations are not experienced so blatantly, people do not seek help, nor do they stop driving. A dramatic problem of this sort is visual field impairment, whether caused by neurological injury (homonymous hemianopia) or glaucoma (constriction of the peripheral field). Some people with these problems are unaware of them and many are insufficiently aware. Consequently, they do not make the necessary adjustments in their driving behavior.

The older, cognitively at-risk driver could benefit from formal assessment of driving-related capabilities, a service which many occupational therapists are already providing in rehabilitation settings. These services should be helpful in providing older drivers an objective and rational basis for decision making. Assessment procedures, including the Doron Simulator (Kantor et al., 1994; Rossi et al., 1988), the Useful Field of View (Owsley et al., 1991; Ball et al., 1991), the Cognitive Behavioral Driver's Inventory (Engum et al., 1988b; Engum et al., 1989b; Engum et al., 1988b) and interactive video (Schiff et al., 1993), are in various stages of psychometric development and reviews abound. Our own analysis, including a comparative summary, of these procedures may be found elsewhere (Gianutsos et al., 1992b). While psychometric properties, e.g., normative standardization, proven reliability and validity, are important, face (apparent) validity is essential to the clinical value of assessment procedures for driving advisement, since it is the driver who usually must be convinced of the relevance of the findings. Unfortunately, the procedure with the greatest face validity, the on-road behind-the-wheel test, fails to meet any of the psychometric standards. Simulation, therefore, has the greatest potential for achieving both psychometric criteria and apparent validity. Of course, we would agree with Galski et al. (1992) that the simulation must address the significant underlying factors and be interactive, unlike the one they used.

A further issue which none of the above-cited proceures addresses explicitly is judgment - an issue cited by professionals and the public alike. For this reason, Gianutsos developed driving advisement procedures, including the Elemental Driving Simulator (EDS) which solicited self-appraisals from the driver, before performance testing. Poor judgment is inferred when self-appraisals far exceed performance. Clinically, this approach has been useful, especially in rehabilitation settings, allowing the clinician to address the issue of judgment in an objective manner.

The EDS (Gianutsos, 1994; Gianutsos et al., 1992) is a personal computer - based procedure which was designed to facilitate advisement of cognitively at-risk drivers, including people recovering from strokes and head injury, as well as older drivers. The EDS is an "elemental" simulation, in that it was designed to address the cognitive elements of safe driving in a straightforward efficient manner (Gianutsos, 1994; Gianutsos et al., 1992). The EDS evolved from the Driving Advisement System (DAS) which was developed and tested with persons in rehabilitation settings who sought to resume driving following an injury to the brain, e.g., stroke and head trauma (Gianutsos et al., 1992b).

The purpose of the present study was to examine older and younger drivers with Gianutsos' EDS, and to extend the self-report to decisions made about actual driving situations (e.g., intersections, merging into traffic, etc.) and times when a person chooses to drive (e.g., night, high traffic density, highway, unfamiliar places, etc.). What kind of self-report, if any, correlates with simulated driving performance?

Method

Research Participants

There were two groups: (1) Occupational Therapy students from Touro College, and (2) older drivers attending a local senior center who responded to a request for volunteers. All were

currently driving and had no history of significant neurological injury. Data from a third group, the standardization sample for the EDS was available for comparison. This group is a convenience sample ranging in age from 18 to 80 years, with a large number in their 30's and 40's. Specific information about the groups is summarized in Table 1 below.

Table 1

Group Characteristics

Measures	Students (a)	EDS Norms *(b)	Seniors (c)	Signif .p < .05
N	20	103	19**	
Age	26.32	36.79	75.51	a<>b<>c
Annual Miles	16,200	13,320	7,053	a<>b<>c
Annual Violations	.15	.11	0	b<>c
Annual Crashes	.10	.17	.05	b<>c
Practice Time (min)	3.68	2.92	9.56	a<>b<>c
EDS: Performance Avg.	99.76	100.00	68.74	a&b<>c
EDS: Self-Appraisal	104.20	103.39	105.53	b<>c
DSR: How	105.35	**	103.35	not sig.
DSR: When	109.03	**	97.13	a<>c
DSR: Overall	106.56	**	100.77	a<>c

*** Group "b" (EDS Norms) were never given the DSR.**

**** Excludes one 90 yr. old senior who was unable to learn the baseline steering task of the EDS and one who withdrew from the study after Phase 1.**

Procedures

The procedures were conducted in individual test sessions with the subject seated in front of a personal computer (IBM compatible). A ten inch steering wheel with turn signal and a foot pedal were fitted in front of the computer screen, using the EDS "portable" system. The EDS software

was modified to allow presentation of additional items immediately following and in the same format as the EDS self-appraisal items.

EDS. The EDS requires self-appraisals prior to the performance assessments. These ratings are made on a linear scale, displayed on the computer monitor, with anchor points marked "average" and "limit" which are to be considered values for the average safe driver and the lower limit of safety, respectively. This display is illustrated in Fig. 1.

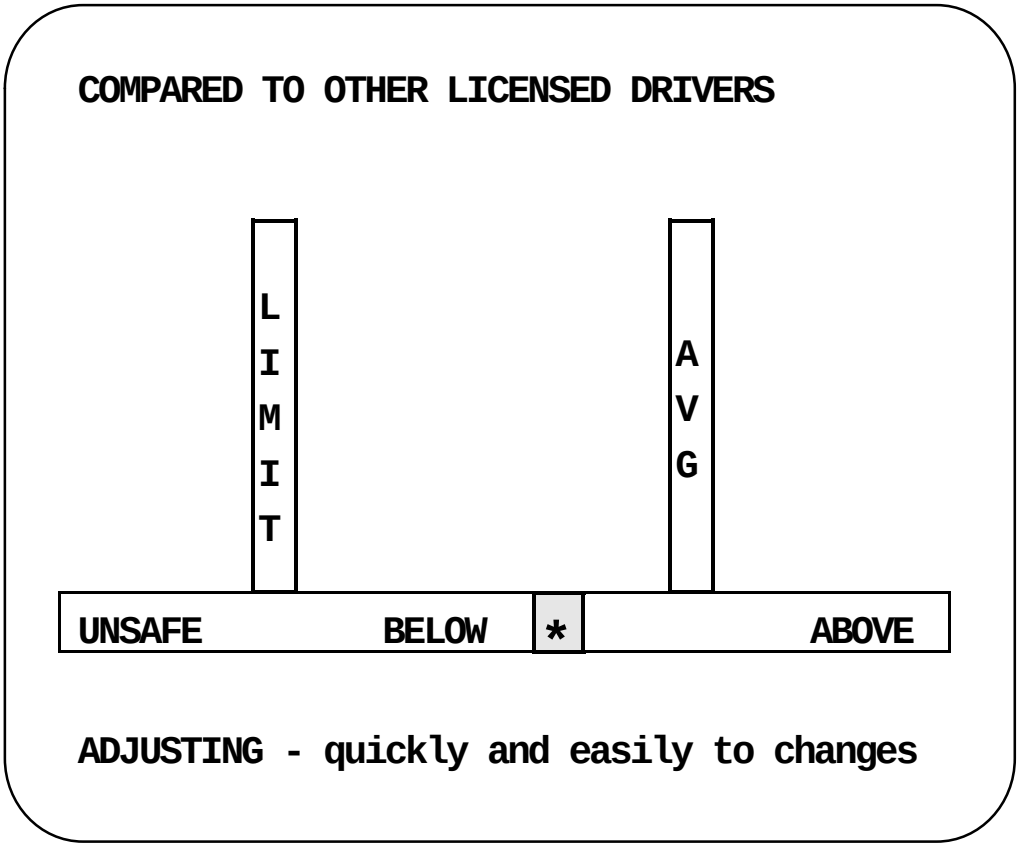


Figure 1. Schematic of self-appraisal screen from the EDS. The individual uses the steering wheel to place the marker (box with asterisk) along the continuum in a position which corresponds to their view of how they compare with other drivers. In this example, the rating implies a self-estimate of below average ability to adjust to complexity.

EDS Ratings are to be given for aspects of driving, including steering coordination, reaction time, impulse control, adjusting quickly and easily to changes, and consistency, as detailed in Table 2.

Table 2

Elemental Driving Simulator: Self-Appraisal Items

Item	Description	Driving examples
STEERING CONTROL	Steadiness and coordination	Narrow 2 way streets Mountain roads Parking
SPEED OF REACTION	Simple reaction time	Sudden presence of hazard Emergency response
FIELD OF VISION	Aware of the far left and far right	Aware of vehicles in other lanes on highway Pedestrians, cyclists entering roadway Intersection events
ADJUSTING	Quickly and easily to changes	Unexpected (other) driver error Rental or borrowed car Driving on the other side of the road Construction zone changes Accident has just occurred Weather changes (e.g., hail)
SELF-CONTROL	Resist the urge to act quickly when more thought is required	Deciding when to pass another car Deciding when to merge onto highway (Not) making turns/lane changes at the last minute (Not) advancing when other traffic does, even though they have the light and you don't (Not) advancing on delayed green
CONSISTENCY	Driving in the same way	(Not) accelerating and decelerating rapidly (Not) making frequent lane changes

Verbal instructions encourage a forthright estimate of current levels of performance and carefully avoid creating the impression that high ratings are desired by the examiner. Below average ratings are still within the "safe" range and show a "concern" on the part of the driver.

On the EDS these self-ratings are compared subsequently with actual performance on three progressively complex simulation tasks. This comparison is interpreted as addressing an aspect of judgment, on the assumption that good judgment is predicated on knowing one's abilities.

The first of the three EDS simulation procedures is an "On the Road" baseline task in which the driver uses a steering wheel to keep a marker (their vehicle) as steadily in the center of a moving set of parallel lines (the road). Since the vehicle is positioned low on the screen, there is an advance view of the road ahead, much as there is in actual driving. This phase is introduced with as many practice runs of about .6 min as the individual desires. Following each practice run, there is graphic feedback of the individual's performance in reference to the performance of norms, using the same linear scale used earlier for self-ratings. The test run is approximately 1 min. Lateral position on the road is measured 8 times per sec and the steadiness of steering is captured by the standard deviation of these measures of relative position.

The second phase of the EDS simulation involves the same baseline steering task, with the additional requirement to monitor the left and right side of the screen for a small face symbol and to turn the directional lever quickly towards the face. Reaction times for left and right side stimuli are thus obtained. Again the individual is allowed to practice as much as desired; the test run takes approximately 2.5 min with 10 trials randomly presented on the left and right sides. If the individual turns in the wrong direction, the error is recorded and the trial re-presented later, so that reaction times are based only on correct trials. If there are errors, there will be more than 10 trials. During practice runs, the individual is given feedback on errors, steering steadiness and reaction time, again based on the performance of the normative group.

Phase 3 includes the tasks of Phase 2 with an additional condition where the face flashes ("to signify a hazard") and the response is to signal in the opposite direction. Here, errors occur more often, and the instructions urge accuracy over speed. During practice, feedback for errors halts the procedure with specific instructions and the examiner permits resumption only when the rules are clear.

Driver Self Report. The Driver Self Report (DSR) is a companion set of self-ratings which address "how" (9 items, Table 3 below) the driver handles certain driving situations and "when" (7 items, Table 3) the person chooses to drive, e.g., at night, on highways, in high traffic areas, etc. They were added to the EDS protocol and immediately followed the six EDS self-appraisal items, and therefore, there were 22 items overall. The same anchor points, namely, the "average" driver and the "limit" of safety were used.

Table 3

Driver Self Report

"How" items	
SIGNAL	Intentions and check the rear when changing lanes
SEAT BELT	Wear a seat belt
INTERSECTIONS	Aware of events at busy intersections
MERGING	Into traffic on a crowded highway
WHEN OTHERS ARE WRONG	Staying calm and in control
CONCENTRATION	Keeping mentally focused while driving
DEFENSIVE DRIVING	Thinking a few steps ahead of the other guy
SPEED CONTROL	Not too fast and not too slow
WHAT OTHERS THINK	Do they have confidence in my driving?
"When" items	
IN RAIN OR FOG	Drive just as much as others do
IN SNOW OR SLEET	Drive just as much as others do
AT NIGHT	Just as much as others do
HIGHWAYS	Just as often as others do
HIGH TRAFFIC AREAS	As much as others do
UNFAMILIAR ROADS	As often as others do
TRIPS OVER AN HOUR	As often as others do

Results

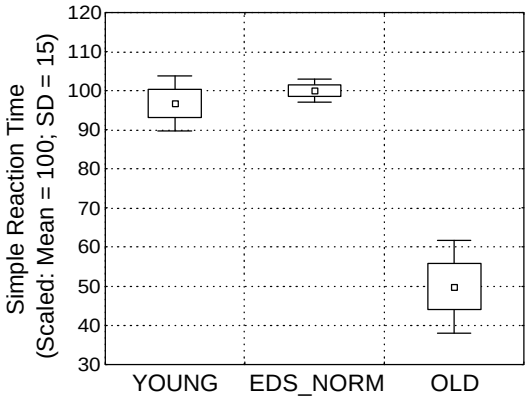
Statistical analysis was accomplished by importing EDS performance data (saved automatically by the computer during the EDS) into a Quattro Pro spreadsheet for data verification and computations of derived variables. The resulting values were imported into the CSS / Statistica

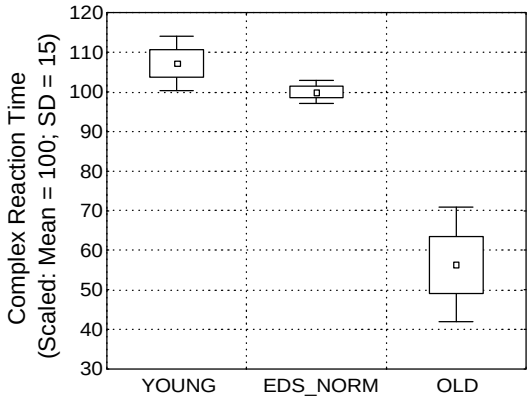
(1996) program for descriptive and inferential analysis. The statistical significance of group differences and bivariate relationships was appraised at the .05 level.

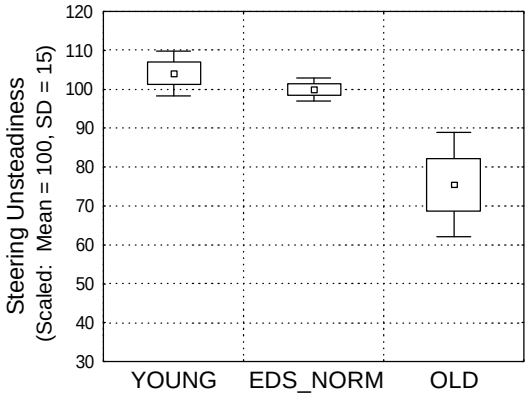
All of the students and 17 out of 21 older drivers completed the EDS. Two of the remaining seniors completed all but the most difficult condition (Phase 3). In a previous study of older community residing drivers (Brown et al., 1993) completion was so much of a problem that the number of EDS phases completed was used as the outcome measure, rather than specific task performance. However, in that study, for practical reasons, practice was limited to approximately what the norms elect without restriction; whereas, in the present study we allowed, indeed, encouraged, participants to practice.

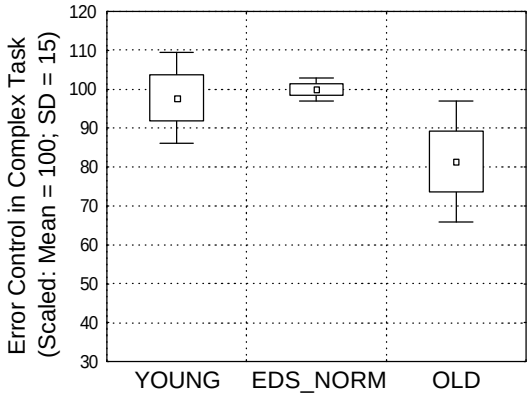
The older drivers opted for considerably more practice than (avg. = 9.56 min) than the younger ones (avg. = 3.68 min.). Even with the additional practice, as a group, the older drivers performed less well than the younger group on virtually every measure, see Fig. 2. The fact that the seniors' confidence interval (the "whisker" on Fig. 2) did not overlap with the means of the other

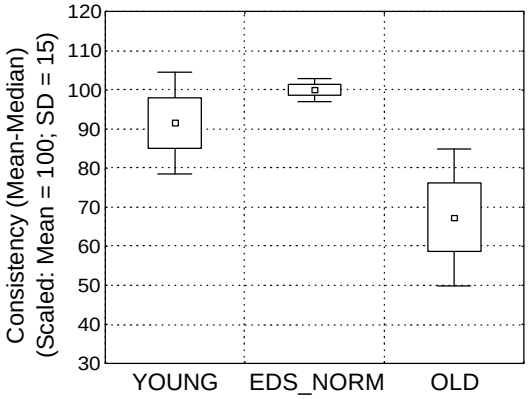
groups indicates that these group differences were statistically significant, $\underline{p} < .05$.











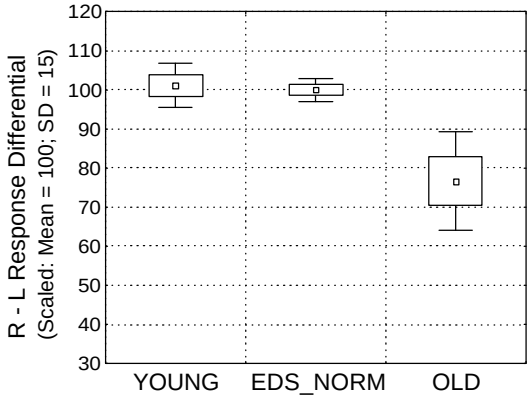


Figure 2. EDS performance measures for the older (OLD), younger (YOUNG) and previously-published EDS norm (EDS_NORM) drivers. The whiskers represent an approximate 95% confidence interval, i. E., 2 standard errors above and below the group mean. Generally, a group is reliably different from another group if its whisker does not encompass the other group's mean.

On the EDS Self-Appraisal measures the older drivers gave themselves slightly higher ratings (avg. = 105.53) than the younger drivers (avg. = 104.20), though this difference was not statistically significant. Nor was there any correlation between these ratings and simulator performance, r = .003, see Fig. 3. On the other hand, when it came to the Driver Self Report ratings, the older drivers rated themselves lower than the younger drivers (100.77 vs. 106.86), especially on the "when" items (97.13 vs. 109.03). Further, these ratings, illustrated in Fig. 4, correlated highly with overall EDS performance, r = .69.

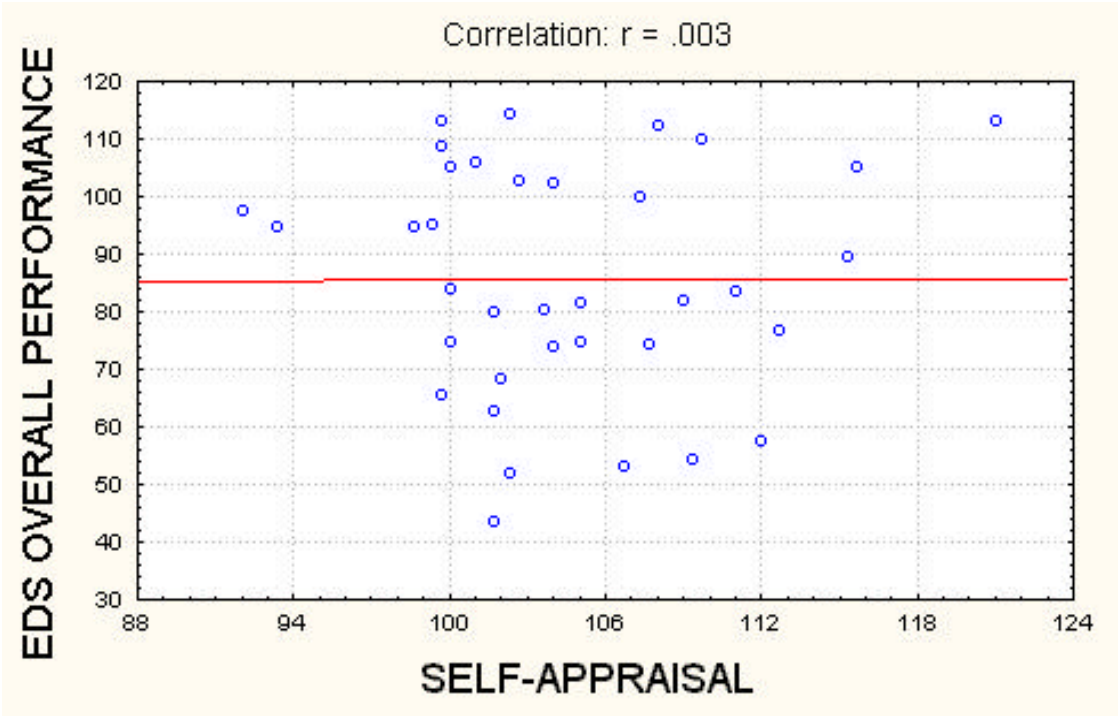


Figure 3. Overall EDS performance and EDS self-appraisal. Each point represents an individual subject. The distribution shows that there is no relationship between performance and self-appraisal. Further, EDS self-appraisal rarely dipped below average; whereas performance did.

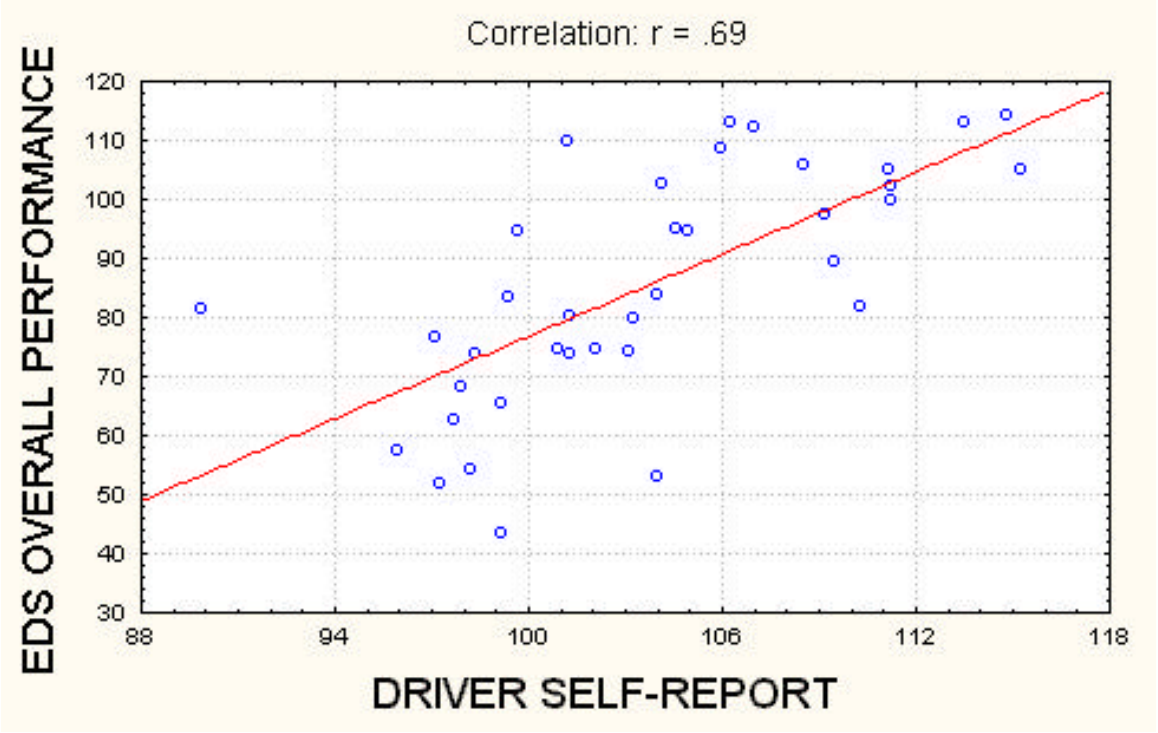


Figure 4. Overall EDS performance and Driver Self Report. Here there was a distinct positive correlation. Self-reports remained generally higher than performance; however, a larger number of subjects, most of them seniors, gave themselves below average ratings.

Discussion

On the EDS the seniors did not perform as well, yet gave themselves slightly higher self-appraisals than the younger subjects. These findings are consistent with earlier results (Gianutsos, 1994) and substantiate the reliability of the EDS as a measurement tool, a finding which is particularly reassuring given the small samples in the present study. Furthermore, in this study we have shown that healthy older drivers can usually complete the EDS, provided they are encouraged to avail themselves of extended opportunities to practice.

The perplexing lack of a relationship between EDS self-appraisal and performance is resolved by the moderate correlation between the Driver Self Report items, particularly those that pertain to when the individual drives. These findings suggest performance-related limitation of driving in drivers who are experiencing age-associated decline in aspects of cognitive function related to driving.

Furthermore, the insistence of older drivers that they remain capable of driving (viz., “after all, I’ve been driving for 50 years...”) is a psychologically significant expression of self-validation. However, these self-appraisals are not necessarily to be taken as an assertion that they can or will drive in the same manner, to the same extent, or in the same situations as they would have decades earlier.

Taken together, these findings, reinforce the importance of psychological sophistication in addressing the issue of driving in persons who have experienced age-associated cognitive changes. The objective is to enable these drivers to drive within their limits, which, of course, depends on their knowing, if not admitting to, these limitations. For experienced drivers, feeling that one can drive is important to the feeling of being in control and often to the validation of one's sense of self. Counseling is in important part of the driving advisement process and should emphasize that controlling one's destiny can be expressed by choosing to control one's mobility in the interest of safety.

Meanwhile, administration of the EDS will include the DSR items which best relate to EDS performance. The DSR would also be a useful adjunct to other driving advisement measures. It will be especially interesting to see how applicable the DSR is to drivers in rehabilitation settings who will have to give prospective ratings. In effect, these individuals will be addressing how they intend to drive, with whatever changes in capabilities they experience consequent to their injury / illness.

Acknowledgment

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