

# Decrement in skill observed after seven hours of car driving<sup>1</sup>

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The performance of six car drivers was assessed over a 3½ mile route in city traffic at 9 a.m. and 4-15 p.m. on two days. On one they also drove alone between the tests, on the other they did laboratory work. Six experienced drivers judged performance on the p.m. test to be worse when driving had continued. The decrement occurred mainly in perceptual skills and courtesy shown towards other road users, rather than in motor skills.

The subjective effects of prolonged driving are well known, but attempts to measure changes in driving performance objectively have largely been unsuccessful (Crawford, 1961). Changes in psychomotor performance on other simple tasks after driving have been demonstrated (McFarland & Moseley, 1954) and sophisticated statistical techniques have isolated decrements in performance on special driving tests given after prolonged periods on the road (Herbert & Jaynes, 1964). However, it is difficult to assess these changes in terms of good or bad driving in real traffic. Even where tests have been given in city traffic over a 12 hr. period, no reliable change in driving skill or "reserve capacity" (Brown, 1964) has been demonstrated (Brown, 1965, 1966).

One major difficulty in direct objective measurements of driving under real conditions is that the stimuli to which the driver is responding cannot be established with certainty, nor recorded precisely. A possible solution to this problem is to make use of observers, skilled in driving, to detect the relevant stimuli and judge the appropriateness and proficiency of the driver's response. The present experiment tested the reliability with which this method measured possible changes in skill resulting from 7 hr. of driving.

## Method

Four male and two female drivers, ranging widely in skill and experience, were each tested on two days with an interval of one week. At 9 a.m. on both days they drove three times around a 3-1/2 mile route in city traffic, taking a different pair of judges each time. This procedure was repeated at 4:15 p.m. on both days. Between the two tests on one day they continued driving alone, on main roads selected by the E, taking only one break of 15 min. (mean distance travelled=193 miles, SD=14 miles). On the other day they carried on with their normal laboratory work between tests (mean distance travelled=16 miles). They were instructed always to drive normally as if alone in the car.

The six judges were members of the Mid-Anglia

Constabulary Traffic Division. All had received advanced levels of instruction in police methods of driving. They had three tasks to perform at 9 a.m. and 4:15 p.m. on both days with each driver: (1) they operated a silent, concealed, push-button to record occasions when the driver's performance deviated from their own standard of driving, (2) after each test they completed a questionnaire by ringing one of four answers to each of eight questions on different aspects of the driver's performance, (3) after the p.m. test they estimated whether driving had or had not been continued during the day, and they rated their confidence in this estimation on a four-point scale.

The order in which the two main conditions were tested was balanced among drivers, and each judge kept the same seating position in the car and the same order of testing throughout the experiment.

## Results

The increase in driving faults from a.m. to p.m. was significantly greater when driving had been continued than when it had not ( $p=0.025$ , Wilcoxon test, see Siegel, 1956, p. 75).

Overall scores on the questionnaire were lower after the p.m. test on both days than after the a.m., and the difference was greater when driving had been continued. However, these changes were not statistically reliable and the data were therefore analyzed in greater detail. Three questions relating to perceptual skills (anticipation of traffic changes, positioning on the road, speed in reacting to unexpected demands) were compared with two relating to motor skills (competence in using hand and foot controls, acceleration imposed on the vehicle) and with three relating to courtesy shown toward other road users (use of turning signals, conformity with speed restrictions, precedence given to other traffic at junctions). Scores on perceptual skills and courtesy were not affected differentially by the period of continued driving ( $p>0.05$ , Wilcoxon test), but when pooled, these two categories of driving behavior showed a significantly greater deterioration after continued driving than did motor skills ( $p=0.025$ , Wilcoxon test).

Estimates of whether driving had continued between tests were not correct significantly more often than would be expected by chance ( $\chi^2=0.06$ ,  $p>0.05$ ). A post-test investigation of criteria used by the judges in making the estimation revealed that continued driving of this duration was expected to improve the performance of the relatively inexperienced drivers. Table 1 shows that, in fact, it did not. There was no

Table 1. Mean number of faults per driver, indicated by push-button responses (N = six judges).

Time of test	Driving continued between tests	Driving not continued between tests
9 a.m.	7.5	8.0
4-15 p.m.	10.4	7.8

significant difference between the confidence ratings of these estimations made on the two days of testing ( $p > 0.05$ , Wilcoxon test).

#### Discussion

The results demonstrate, as expected, that immediate recording of driving faults provided the most sensitive method of assessing driving subjectively. A delayed and more detailed assessment was effective, but less efficient than immediate recording, and individual interpretations of correct information, obtained subjectively, were unreliable. Perhaps the most surprising result is that there was sufficient agreement between judges on the recording of driving faults to reveal a statistically reliable effect of prolonging driving for 7 hr., whereas intensive objective measurement has failed to demonstrate it.

To the experienced judges, perceptual skills and courtesy shown toward other road users deteriorated more after prolonged driving than did motor skills. This may simply indicate that decrements in motor skill are difficult to detect subjectively, but there is some evidence from objective studies (Gagné, 1953) that motor performance is little affected by prolonged work.

It remains to be seen whether these differential effects of driving fatigue result simply from changes in the criteria on which drivers select relevant stimuli, such as have observed in laboratory studies of vigilance (Broadbent & Gregory, 1966), or whether they result from a genuine reduction in the driver's capacity for transmitting information from the environment.

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#### Note

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