

Correlation between clinical tests and driving simulator performance of commercial drivers in the United States

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Study Introduction

- Driving requires intact cognitive and visual skills to perform safely
- Driving commercial vehicles requires even more advanced skills
- Approximately 1.7 million long-haul truck drivers in the USA,
- Federal Motor Carrier Safety Administration of the USDOT is to improve safety on our nation's highways
- Reducing the number of accidents that involve commercial truck drivers, including hazardous & non-hazardous material transportation



Study Introduction

- **We, at the University of Kansas Medical Center, received grant funding from the Department of Transportation (DOT) to:**
 - 1) Explore cognitive and visual fitness of commercial drivers ages 18+, in any sector annually, over 3yrs**
 - 2) Correlate results of a simulated driving performance with clinical tools that best predict performance**
 - 3) Use findings to advise DOT on fine-tuning their annual assessments to improve driving fitness of commercial drivers**
 - 4) Provide rehabilitation options for problematic domains**



Study Purpose

1. **Assess CDL drivers' cognitive and visual fitness**
2. **Identify the top 5 tests that correlate with on-the-road driving safety for CDL drivers**
3. **Evaluate the effect of an intervention program to improve reduced visual, cognitive and driving skills to enable CDL drivers drive for longer**



Recruitment Resources

- Recruitment began fall 2018
 - Legal clearance had to be done during 2017-18
- Internal/ KUMC Database
- International and National Transportation Companies
- National and Local Supermarkets
- National and Local Truck Companies
- Truck Stops



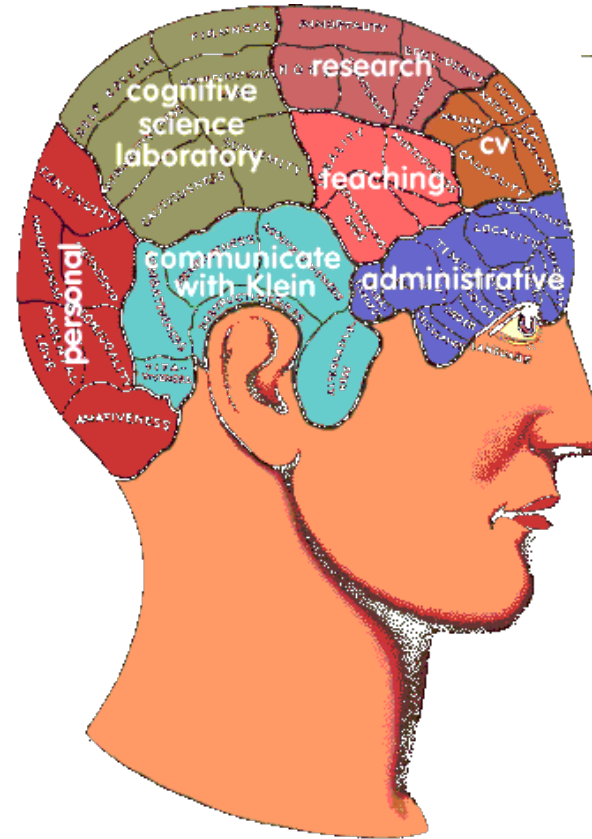
Methods

All 30 participants

- **Demographic and Clinical Information; Cognitive Assessment; Visual Assessment; Range of Motion & Gait Speed; Simulated practical driving assessment; Task Evoked Pupillary Response (TEPR) ^{3,4}**
- **All assessments for each took place on the same day, the order was randomized; and took about 2 hours to complete**
- **Each subject completed 3 annual visits, compensated \$50 per visit (\$150 total), and encouraged to share e-log driving data**
- **This presentation covers year 1 data**

Cognitive Assessment

- Stroke Drivers Screening Assessment ⁴
- Useful Field of View
- The Montreal Cognitive Assessment
- Trail Making Tests A and B
- Snellgrove Maze



Simulator Assessment

- 20-30 minutes
- A drive in daily-life traffic while obeying the rules of the road
- Car following abilities under low and high cognitive demand
- Brake response time, lane deviations, pedestrians hit, daily-life driving skills, attention; and TEPR data were collected



Results

- **34 participants, 31 completed simulator portion**
- **Data was complete for 29/31**

Variables	Data (SD)
Gender, F / M	3 Females / 28 Males
Age, yrs	Mean age = 53 (13) yrs
Weight, lbs ; Height, inches : BMI	225lbs ; 71" : BMI = 32 (6)
Education, yrs	Mean years of education = 14 yrs
CDL driving experience, yrs	Mean CDL experience = 30 (12) yrs
CDL annual mileage, miles	Mean CDL annual mileage = 33,000
Medication, number	0 – 11 (average 1.9)
Tickets / Accidents in last 5 years, number	0 / 0

Variables	Result (IQR)
MOCA, number	27 (25-28)
Trails A, second	27.6 (23.5-35.6)
Trails B, second	66.0 (52.34-93.86)
Maze, second	29.45 sec
UFOV Speed of Processing, msec	14.8 (14.8-15.1)
UFOV Divided Attention, msec	15.1 (14.8-22.1)
UFOV Selective Attention, msec	108.5 (61.5-148.1)
SDSA, pass / fail	29 / 2
Range of Motion	All normal
Timed Up and Go, second	7.25 (1.9)

Results of Self-reported data and Simulator Performance

- A significant correlation was also found between annual mileage as a CDL driver and “Complex Reaction time, $r_s = 0.4$, $p = .02$

Results of UFOV and Simulator Performance

- Selective Attention (UFOV) yielded the highest number of significant correlations with speed exceedance, duration of speed exceedance, and distance during speed exceedance
- Divided Attention (UFOV) was significantly associated with “Time Out of Lane” ($r = 0.37$, $p = .0451$) and “Distance Out of Lane” ($r = 0.46$, $p = .0112$)

Results of Cognitive Tests and Simulator Performance

- MoCA was significantly associated with “Pedestrians Hit” ($p=.032$), “Road Edge Excursions” ($p=.0497$), “Distance Over Speed Limit” ($p=.0814$), and “Distance Out of Lane” ($p=0.0095$)
- An inverse association was seen between time with Trail-making test A and “Pedestrians Hit” ($r_s. = -0.36, p < 0.05$)
- The time taken on the Dot Cancellation test and the time out of the driving lane on the simulator, were inversely associated ($r = -0.40, p < 0.05$)

Results of Cognitive Tests and with self-reported Data

- Trail-making B test time and CDL driving years were significantly associated ($r_s = 0.41$, $p = .0226$)
- Trail-making test B was associated with years of education ($r_s = 0.37$, $p = .0410$)
- The speed of processing (UFOV) had the highest number of statistically significant correlation with CDL Annual Mileage
- Divided and Sustained Attention (UFOV) were associated with age ($r_s = 0.37$, $p = .0417$ and $r_s = 0.54$, $p = .0018$)
- Errors on the dot cancellation test was associated with both number of Medications ($r_s = 0.40$, $p = .0256$) and CDL driving experience ($r_s = 0.49$, $p = .0044$)

Results

- When compared with simulator performance, Sustained Attention (UFOV) had the highest correlation with other variables
- Center line deviations were most correlated with the number of medications the CDL driver was taking

Conclusion

- Preliminary baseline analysis demonstrates a population with obesity, high levels of CDL driving experience and strong performance on cognitive and physical measures
- Visual testing, however, was poor indicating the need for closer visual testing for CDL drivers, despite annual physicals

Future Steps

- Correlating these results with year 2 and year 3 data and on-the-road driving safety measured by self-assessment questionnaires to be completed at each assessment
- A review of their driving log data looking at near misses, speed violations, and accidents
- Goal would be to translate these results to a quick, inexpensive clinical toolkit that providers can use to assess the driving fitness of commercial drivers

References

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THANK YOU!

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