

Project Title

Fatigue, Health and CMV Driving Behavior during the COVID-19 Pandemic

University

University of Denver

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Research Needs

Improving transportation safety is the number one strategic goal of the US DOT Specifically, “Reduce Transportation-Related Fatalities and Serious Injuries Across the Transportation System.”¹ Fatigue has been thought to be a major factor contributing to accidents. A recent publication from NHSTA estimates that from 2 percent to 20 percent of annual traffic deaths are attributable to driver drowsiness.² According to NHTSA, annually on average from 2009 to 2013, there were over 72,000 police-reported crashes involving drowsy drivers, injuring more than an estimated 41,000 people, and killing more than 800, as measured by NHTSA’s Fatality Analysis Reporting System (FARS) and National Automotive Sampling System (NASS) General Estimates System (GES).³ FARS is a census of all fatal crashes that occur on the Nation’s roadways. NASS GES contains data from a nationally representative sample of police-reported crashes that result in fatality, injury, or property damage. Using these data bases, one study inferred the existence of additional drowsy-driving crashes by looking for correlations with related factors such as the number of passengers in the vehicle, crash time and day of week,

¹ DOT Strategic Plan. <https://www.transportation.gov/dot-strategic-plan> (from web August 16, 2018.)

² 2015 Lifesavers National Conference on Highway Safety Priorities, Mark R. Rosekind, Ph.D., Administrator, NHTSA (March 16, 2015). Retrieved from www.nhtsa.gov/About+NHTSA/Speeches,+Press+Events+&+Testimonies/remarks-mr-lifesavers-03162015

³ National Center for Statistics and Analysis. (2011, March). Traffic Safety Fact Crash*Stats: Drowsy Driving. (DOT HS 811 449). Washington, DC: NHTSA. Retrieved from www-nrd.nhtsa.dot.gov/pubs/811449.pdf

driver sex and crash type. Similarly, another study was conducted by the AAA Foundation for Traffic Safety and analyzed data from NHTSA's NASS Crashworthiness Data System (CDS). They estimated that 7 percent of all crashes and 16.5 percent of fatal crashes involved a drowsy driver. This suggests that more than 5,000 people died in drowsy-driving-related motor vehicle crashes across the United States in the study year.⁴

Each year over 40,000 people die in traffic accidents and crashes. In addition, more than 3.5 million people work as truck drivers which is one of the largest occupations in the USA. Although many truckers work a regular 40-hour workweek, almost half of truckers work longer hours. In comparison, about a quarter of workers in all occupations work more than 40 hours a week.⁵

Also a total of 2,734 fatal crashes involving trucks and buses were reported in the United States in 2019. A total of 3,087 people died in those crashes according to the preliminary report released in January 2020. Another 60,818 people were hurt in crashes involving large trucks and buses, and 122,331 vehicles were damaged or wrecked.⁶ A typical U.S. driver usually travels 12,000 to 15,000 miles every year and has a 1 in 15 chance of being in a crash. But most fleet drivers travel 20,000 to 25,000 miles or more every year, increasing their chance of being in an accident. In 2018, 5,096 large trucks and buses were involved in fatal crashes, a 1-percent increase from 2017.⁷ Unfortunately, from 2017 to 2018, the number of fatal crashes involving large trucks or buses increased by 1 percent.⁸ More concerning, from 2016 to 2018, according to NHTSA's CRSS data, large truck and bus injury crashes increased 8 percent (from 112,000 in 2016 to 121,000 in 2018).⁹

Understanding and predicting the occurrence of traffic accidents and crashes is an important endeavor for those concerned with improving the safety of the driving public. Recently, an important factor related to the occurrence of crashes, injuries and fatalities has been operator fatigue. Also related to the occurrence of vehicular crashes has been the presence of aggressive driving behaviors such as reckless driving, risk taking and following too closely. These behaviors are also associated with symptoms of drowsiness. The National Sleep Foundation lists: 1) Difficulty focusing, frequent blinking, or heavy eyelids; 2) Daydreaming; wandering/disconnected thoughts; 3) Trouble remembering the last few miles driven; missing exits or traffic signs; 4) Yawning repeatedly or rubbing your eyes; 5) Trouble keeping your head up; 6) Drifting from your lane, tailgating, or hitting a shoulder rumble strip; and 7) Feeling restless and irritable as signs that suggest drowsiness. Note that tailgating and irritability are also associated with aggressive driving.¹⁰

⁴ Tefft, B. C. (2012). Prevalence of motor vehicle crashes involving drowsy drivers, United States, 1999-2008. *Accident Analysis & Prevention*, 45(1): 180-186.

⁵ <https://www.census.gov/library/stories/2019/06/america-keeps-on-trucking.html#:~:text=More%20than%203.5%20million%20people,occupations%20in%20the%20United%20States>

⁶ <https://www.ftsgps.com/resource-center/30-of-deaths-in-bus-and-truck-crashes-in-2019-were-in-three-states/>

⁷ <https://www.fmcsa.dot.gov/safety/data-and-statistics/large-truck-and-bus-crash-facts-2018>

⁸ <https://www.fmcsa.dot.gov/safety/data-and-statistics/large-truck-and-bus-crash-facts-2018>

⁹ <https://www.fmcsa.dot.gov/safety/data-and-statistics/large-truck-and-bus-crash-facts-2018>

¹⁰ <https://drowsydriving.org/about/warning-signs/>

Recently, Gottlieb, et. al. (2018) studied the relationship between sleep duration and motor vehicle crashes in a sample of 3201 adults, 222 (6.9%) reported at least one motor vehicle crash during the prior year. Fewer hours of sleep ($p = 0.04$), and self-reported excessive sleepiness ($p < 0.01$) were each significantly associated with crash risk. Severe sleep apnea was associated with a 123% increased crash risk, compared to no sleep apnea. Sleeping 6 hours per night was associated with a 33% increased crash risk, compared to sleeping 7 or 8 hours per night. These associations were present even in those who did not report excessive sleepiness. The population-attributable fraction of motor vehicle crashes was 10% due to sleep apnea and 9% due to sleep duration less than 7 hours. Thus, poor sleep, due to either sleep apnea or insufficient sleep duration is strongly associated with motor vehicle crashes in the general population, independent of self-reported excessive sleepiness.¹¹

A meta analytic review of studies designed to investigate the relationship between sleepiness at the wheel and motor vehicle accidents was conducted in 2017. The authors concluded that drivers experiencing sleepiness at the wheel are at an increased risk of motor vehicle accidents.¹²

The Federal Motor Carrier safety Administration (FMCSA) Hours of Service (HOS) rules are based on the Federal Motor Carrier Act of 1935 (1935 Act) and the Federal Motor Carrier Safety Act of 1984 (1984 Act). The 1935 Act, states that “The Secretary of Transportation may prescribe requirements for—(1) qualifications and maximum hours of service of employees of, and safety of operation and equipment of, a motor carrier; and (2) qualifications and maximum hours of service of employees of, and standards of equipment of, a motor private carrier, when needed to promote safety of operation.¹³

The HOS regulations¹⁴ require:

- **11-Hour Driving Limit** - a maximum of 11 hours after 10 consecutive hours off duty.
- **14-Hour Limit** - May not drive beyond the 14th consecutive hour after coming on duty, following 10 consecutive hours off duty. Off-duty time does not extend the 14-hour period.
- **30-Minute Driving Break** - Drivers must take a 30-minute break after driving for 8 cumulative hours without at least a 30-minute interruption. The break must be any non-driving period of 30 consecutive minutes
- **60/70-Hour Limit** - May not drive after 60/70 hours on duty in 7/8 consecutive days. A driver may restart a 7/8 consecutive day period after taking 34 or more consecutive hours off duty.
- **Sleeper Berth Provision** - Drivers may split their required 10-hour off-duty period, as long as one off-duty period (whether in or out of the sleeper berth) is at least 2 hours long and the other involves at least 7 consecutive hours spent in the sleeper berth. All sleeper

¹¹ Gottlieb, D. J., Ellenbogen, J. M., Bianchi, M. T., & Czeisler, C. A. (2018). Sleep deficiency and motor vehicle crash risk in the general population: a prospective cohort study. *BMC medicine*, 16(1), 44. doi:10.1186/s12916-018-1025-7.

¹² Bioulac, S., Micoulaud-Franchi, J. , Arnaud, M., Sagaspe, P., Moore, N., Salvo, F., Philip, P. (2017). Risk of Motor Vehicle Accidents Related to Sleepiness at the Wheel: A Systematic Review and Meta-Analysis, *Sleep*, Volume 40, Issue 10, October 2017, zsx134, <https://doi-org.du.idm.oclc.org/10.1093/sleep/zsx134>

¹³ <https://www.federalregister.gov/documents/2020/06/01/2020-11469/hours-of-service-of-drivers>

¹⁴ <https://www.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations>

berth pairings MUST add up to at least 10 hours. When used together, neither time period counts against the maximum 14- hour driving window.

- **Adverse Driving Conditions** - Drivers are allowed to extend the 11-hour maximum driving limit and 14-hour driving window by up to 2 hours when adverse driving conditions are encountered.
- **Short-Haul Exception** - A driver is exempt from the preceding requirements if the driver operates within a 150 air-mile radius of the normal work reporting location, and the driver does not exceed a maximum duty period of 14 hours. Drivers using the short-haul exception (1) must report and return to the normal work reporting location within 14 consecutive hours and stay within a 150 air-mile radius of the work reporting location.

These recent changes purport to increase driver flexibility while maintaining safety.¹⁵

On March 13, 2020 the Federal Motor Carrier Safety Administration (FMCSA) suspended the 82-year-old hours-of- service (HOS) rules for commercial vehicles delivering relief in response to the coronavirus outbreak.¹⁶ The suspension of the HOS rules may create increased risk from drowsy driving and driver fatigue. According to the CDC, drowsy driving decreases drivers ability to pay attention to the road, slows reaction times and affects drivers' ability to make decisions. The CDC believes that drowsy driving may be responsible for up to nearly 1000 fatal crashes annually.¹⁷ The Large Truck Crash Causation Study (LTCCS) reported that 13 percent of commercial motor vehicle (CMV) drivers were considered to have been fatigued at the time of their crash and that the relative risk of being involved in a crash when fatigued was 8 times greater than when not fatigued.¹⁸

Efforts to identify operators and drivers who might experience fatigue or sleepiness when operating a motor vehicle have been on identifying person who might experience fatigue in the near future as well as monitoring drivers. Technology is under development to assess driver performance, while driving, related to fatigue. However, the need to identify operators fatigue levels and potential for decreased performance due to fatigue *before they begin to operate a vehicle* is of considerable importance as well. Once an individual has begun to operate a vehicle even more risk is encountered. In addition to measuring the degree of fatigue present before an operator begins to operate a vehicle there is evidence to suggest that certain attitudes, behaviors and behavioral characteristics are associated with the likelihood of driving aggressively and with little regard for the other drivers.

Personality and Accidents/Crashes

Murray et al. (2006) developed a model for predicting a truck crash involvement using logistic regression using driver's historical driving record and later used the significant factors identified to plan for effective enforcement actions to counteract the driving behaviors. The model

¹⁵ <https://www.federalregister.gov/documents/2020/06/01/2020-11469/hours-of-service-of-drivers>

¹⁶ [US Department of Transportation Issues National Emergency Declaration for Commercial Vehicles Delivering Relief in Response to the Coronavirus Outbreak | FMCSA \(dot.gov\)](#)

¹⁷ [CDC - Drowsy Driving- Sleep and Sleep Disorders](#)

¹⁸ [The Large Truck Crash Causation Study - Analysis Brief | FMCSA \(dot.gov\)](#)

suggested that drivers who had a past crash increased their likelihood of a future crash by 87%, in his model reckless driving and improper turn violation were the most important predictors.

Other research has found that a major cause of crashes is aggressive driving, broadly defined as any deliberate unsafe driving behavior (Tasca, 2000, AAA, 2009; see also NHTSA, 2009).³ A recent study by the American Automobile Association (AAA, 2009) estimated that 56% of the fatal crashes that occurred between 2003 and 2007 involved potential aggressive driving behavior, with speeding being the most common potentially aggressive action making up about 31% of total fatal crashes. Other behaviors considered aggressive related to fatal crashes included failure to yield right of way (11.4% of fatal crashes), reckless/careless/erratic driving (7.4%), failure to obey signs/control devices (6.6%), and improper turning (4.1%). (Paleti, Eluru, & Bhat (2010)).

Dahlen (2012) replicated previous research showing a relationship between personality variables and the prediction of accidents in general (e.g., Wallace and Vodanovich, 2003) and MVAs in particular (Arthur and Graziano, 1996). The personality factors the Five Factor Model (FFM) predicted aggressive driving better than accidents. Dahlen found an absolute correlation of ($M|r| = .25$) between the five factors and aggressive driving while that between the five factors and vehicular crashes was ($M|r| = .07$) as compared to the Arthur and Graziano (1996) finding a correlation of ($r = .08$). The six factors of driver personality explained 36% of the variance in aggressive driving, but only 7% of the variance in driving performance (i.e., crashes and moving violations). Thus, driver personality and aggressive driving are clearly related to driver safety, but other factors also contribute.

The issue of whether self-report data is valid and reliable has always been of interest. Some research shows that respondents can fake their responses on measures of the FFM *when instructed to do so in laboratory settings* (e.g., Viswesvaran and Ones, 1999), but the amount of response distortion in job applicant samples is estimated to be much less when instructions are not provided (e.g., Hough, 1998; Ones et al., 1996). In addition, most research indicates that social desirability does not influence the criterion-related validity (e.g., Hough et al., 1990) or the factor structure (e.g., Ellingson et al., 2001) of personality test scores. Therefore, using measures of broad personality constructs could be advantageous over more transparent measures (e.g., driving anger) in applied situations where respondents might be inclined to minimize their shortcomings (e.g., traffic court, driver training, and the selection of professional drivers).” (Dahlen, et al. , 2012)

Owsley (2003) found that personality characteristics such as impulsiveness have been linked to the driving safety and driving. Using the IVE questionnaire impulsiveness, venturesomeness, and empathy were measured in 305 older drivers (ages 57–87 years old). Study participants who reported four or more driving errors had higher impulsivity and empathy scores and lower venturesomeness scores. Persons reporting driving violations were more likely to have high impulsivity scores. Driving six or more places per week was associated with lower levels of impulsivity. The results suggest that self-report personality measures are related to driving behaviors and driving outcomes (Owsely, 2003).

Alavi (2017), extending the notion that attitudes and personality characteristics are related to driving style and behavior examined the relationship between personality and mental disorders

and road accidents. The results revealed that varying levels of depression increased the odds of reporting road accidents by 2.4-fold. Furthermore, the presence of obsessional disorder increased the odds of road accidents by 2.7-fold. Overall, the neuroticism factor of the FFM was more likely to increase crash probability by 1.1-fold.” Alavi (2017)

Fernandez (2020) studied the relationship between various personality characteristics and the Attitudes Toward Safety Regulations Scale (ATSRS). Using several measures of personality including the FFM, a burnout scale, the Swedish occupational fatigue inventory (Ahlsber, 1997) and the Driver Fatigue scale (DF-8) created by the author they found that Emotional Stability and Agreeableness positively predict Enforcement and Effectiveness. Openness to experience negatively predicts General attitudes, while Extraversion negatively predicts effectiveness. Two of the three burnout scales were also been shown to be good predictors for General Attitudes, and Professional efficiency for Enforcement and Effectiveness. Similarly, some characteristics of job content and JDS also only slightly influenced the three dimensions. Professional efficiency (22.7%) and Emotional Stability (22.3%) were the best predictor variables and explained a greater degree of variance.¹⁹

Continuing to examine and review the findings between personality and driving outcomes Wählberg et al. (2017) conducted a meta-analysis on the relationship between personality and crashes. Scores on FFM measures were small but reliable predictors of the number of automobile crashes. Specifically, higher involvement in crashes was positively associated with self-reported levels of extraversion and neuroticism, and negatively associated with self-reported levels of agreeableness and conscientiousness.²⁰

Mamcarz, et. al. (2019) also used the Impulsiveness, Venturesomeness and Empathy scale (IVE) Eysenck Impulsiveness-Venturesomeness-Empathy Questionnaire (Eysenck, 2006) to examine the relationship between personality and traffic accidents. The results showed that there are statistically positive correlations between personality traits and work stress. More importantly, they also found a correlation between personality and different types of traffic incidents.²¹

Nordfjærn & Simsekog̃lu (2014) examined the role of empathy, conformity and driving behaviors in a sample of Turkish urban drivers. Results showed that both traits and cultural factors were associated with driving violations and errors. Using a measure designed to detect empath, defined as the ability to conceive the emotions of others, was related to lower levels of reported driving errors and violations, whereas a tendency to amend behavior in line with behavior of others (conformity) was related to higher levels. The findings highlight the importance of social pressure and social norms influencing driving violations suggesting that interventions aimed at reducing problematic driving behaviors in urban settings should focus on increasing drivers’ resistance to this pressure.²²

Wood (2020) examined the relationship between estimates of ZIP-code-level automobile fatality rates in a dataset comprising 2.8 million responses to a widely used self-report personality

¹⁹ Serrano-Fernández, M. (2020). <https://doi.org/10.1016/j.jth.2020.100967>

²⁰ Af Wahlberg, et. al. (2017). <https://doi.org/10.1016/j.trf.2016.10.009>

²¹ Mamcarz, P., Et. al. (2019). <https://doi.org/10.1016/j.trpro.2019.07.201>

²² Nordfjaer, Et. al. (2014). <http://dx.doi.org/10.1016/j.ssci.2014.02.020>

questionnaire. An area's wealth and population density were controlled and estimated at the slightly larger level of US Census ZIP Code Tabulation Areas (ZCTAs). Rates of fatal crash involvement tended to be higher in areas where respondents were more likely to describe themselves as being depressed, moody, and quarrelsome. Rates of fatal crash involvement tended to be higher in areas where respondents described themselves as more helpful and as less easily distracted. However, many small-area-level associations between self-rated personality and fatality rates were found to be in the same direction across more states than expected by chance indicating that associations were highly reliable and general. Areas in which residents were more likely to endorse the items "is outgoing, sociable," and less likely to endorse the items "is reserved" and "tends to be quiet" tended to have lower automobile fatality rates. Each of these associations were also highly general, being estimated in the same direction for about 80% of the 51 state-specific estimates. Residents in ZCTAs that tended to provide higher endorsement of the items "starts quarrels with others" and "can be cold and aloof" had elevated risk of involvement in automobile fatalities. These relationships were estimated to be positive in at least 75% of all states. These findings suggest that knowing average personality characteristics of the population of given geographic area might be useful in the prediction of local accident rates or setting of insurance rates.

In summary, Dorn & Wahlberg (2020) note that the concept of accident proneness, or personality characteristics that are associated subsequent accidents, provides a basis for understanding that driver behavior is less susceptible to change in the long term, as evidenced by limited effectiveness of all types of driver education and training due to the influence of personality (af Wählberg 2017). Moreover, personality measures could be used as a means for assessing individuals potentially at risk for aggressive driving and or negative driving behaviors in the case of new drivers or selection of commercial vehicle drivers. (Dahlen, et al. , 2012)

Conclusion

As can be seen from the above review, the need for a personality assessment of driver propensities prior to beginning driving is increasingly supported by research and is warranted as it would aide in identifying those drivers likely to be at risk for developing or demonstrating aggressive or otherwise problematic driving behaviors. These unwanted and unsafe driving behaviors could be further exacerbated by fatigue. An assessment of these propensities, if sufficiently valid and predictive of accident involvement, prior to a person beginning operation of a vehicle, would be extremely valuable to the safety of the transportation system.

The purpose of the proposed project is to gather data designed to further validate the role of empathy and other psychological characteristics in the prediction of CMV driver safety and to document the extent of fatigue and psychological associated with the COVID-19 pandemic of 2020.

The proposed project will build on previous research to demonstrate the accuracy of a measure of fatigue and alertness in the transportation industry and hopefully lead to a reduction in accidents and injuries.

Research Objectives

The objectives of this project are as follows

- 1) Conduct a review of current literature on personality, fatigue, and driving behavior.
- 2) Gather data using online smartphone surveys devices from employees of the transportation industry.
- 3) Compare the data gathered previously to other existing measures of fatigue and alertness.
- 4) Determine whether levels of fatigue, empathy, and amount of driving are related to driver safety.
- 5) Determine whether the levels of fatigue, stress, mood, and social isolation are different from pre-COVID levels.
- 6) Examine the role of empathy and other psychological characteristics in the prediction of CMV driver safety
- 7) Document the extent of fatigue and psychological associated with the COVID-19 pandemic of 2020 in comparison to previous assessments.
- 8) Writing of report & development of recommendations.
- 9) Conduct workshop to facilitate technology transfer regarding what has been learned.
- 10) Presentations at key conferences.
- 11) Post final report on web site.

Research Methods

Data will be collected on a sample of healthy truck drivers in a large metropolitan area in the Western United states. The project will utilize an experimental survey questionnaire and other standardized self-report instruments to assess sleep and wakefulness. The data will be analyzed using statistical techniques to review and evaluate the correlation between existing measures and to demonstrate the occurrence of performance decrements with increase wakefulness.

Measures & Data Collection

A number of psychological measures will be contained in a online questionnaire administered online to CMV drivers who agree to participate in the study. The study has been granted IRB approval.

Sleepiness: The Karolinska Sleepiness Scale (KSS) has been used to demonstrate the effects of shift-work on fatigue. Ganesan, et. al. (2019) found KSS and PVT mean reaction times were higher at the end of the first and subsequent night shift compared to day shift, with KSS highest at the end of the first night. In a study of registered nurses working 12-hr shifts (Geiger Brown, J., Wieroney, M., Blair, L. et al. 2014) vigilant attention, as measured by PVT lapses and anticipation responses, showed no significant association with KSS scores; however, mean reaction times were slower (566 ms) for a KSS score of 9 (extreme sleepiness and fighting sleep) compared to reaction time means ranging from 275 to 326 ms for KSS scores of 1–8 in nurses who reported their highest level of sleepiness during the shift ($t = 2.37$; $p = 0.05$). Thus, partial support for the validity of administering the KSS was shown.

Fatigue: A single item visual analog (VAS) measure of fatigue was used in the form of a slider graphic. Respondents moved the slider button to either the 0 – Not fatigued or the 100 – severe fatigue. Two studies reported promising psychometrics for single-item fatigue measures. A single-item fatigue measure (“How fatigued do you currently feel?”; 1–10 scale) showed high

convergent validity in staff at a Dutch university ($r = 0.80$ with the POMS-B fatigue subscale; Van Hooff et al., 2007). Another single-item measure (“I get tired for no reason”; 4-point Likert scale) showed good validity in cancer patients ($r = .70$ with the Functional Assessment of Cancer Therapy-Anemia; Kirsh et al., 2001). Single-item fatigue measures offer a valid way to assess daily fatigue.

Loneliness: The Three Item Loneliness Scale (**TILS**) was described in a study by Hughes, et. al. (2004), with an alpha coefficient of reliability $\alpha=.72$. In addition, persons who scored high on loneliness were more likely to experience depressive symptoms, as indexed by a short form of the Center for Epidemiologic Studies–Depression Scale (CES-D; Turvey, et. al., 1999), and, on average, score higher on the Perceived Stress Scale (Cohen, et. al., 1983; Cacioppo, et. al., 2010). The correlation between R-UCLA Loneliness scale and TILS was found to be $r=.82$ and $r=.48$ with the CESD which was also significant.

Burnout: The single-item burnout measure was based on a single question validated by Rohland, et. al. (2004). Burnout has been shown to be an important measure related to workload, fatigue, and job satisfaction.

Depression: The VAS scale is strongly correlated with the PHQ-9 total score (0.61) and its 9 individual items (ranging from 0.19 to 0.67). ROC analysis shows that the VAS scale has high accuracy for detecting the presence and different levels (mild to severe) of depression corresponding to PHQ-9 cutoffs. The VAS depression scale represents a simple, easily implementable instrument that is suitable for mental health research in common settings and larger population-based studies. A study by van Rijsbergen, et. al. (2014) found the VAMS had the highest positive predictive value (PPV) without any false negatives at score 55 (PPV $\frac{1}{4}$ 0.53; NPV $\frac{1}{4}$ 1.0) and was the best predictor of current relapse status (variance explained for VAMS: 60%; for HAM-D17: 49%; for IDS-SR: 34%). Assessing depression mood with a single-item mood scale appears to be a reasonable method in a sort internet-based assessment tool.

Stanford Sleepiness Questionnaire (SSQ): The SSQ is a standard Likert response scale used to assess the study participant’s self-assessment of their sleepiness (Hoddes , et. al., 1972; Herscovitch & Broughton (1981). The SSQ is administered using a 9-point scale. Responses provide an assessment of the level of sleepiness experienced by the participant.

Number of Accidents, Tickets, and Crashes: The study participants were asked to report the number accidents, tickets or citations, and crashes that they had been involved in over the last year.

Driver Empathy Scale (DES): Chao & Sherry (2016) studied 481 CMV drivers and determined that there were significant correlations between three factors of the Driver Empathy Scale and other self-reported measures of safety, stress, and risky driving behaviors.

Expected Outcomes

The proposed study will document the health and safety of a sample of drivers operating trucks in the Denver Metropolitan area during the 2020 COVID -19 pandemic. Compare the data gathered previously to other existing measures of fatigue and alertness. The study will also determine whether levels of fatigue, empathy, and amount of driving are related to driver safety.

The study will also attempt to determine whether the levels of fatigue, stress, mood, and social isolation are different from pre-COVID levels. In addition, the study will examine driver behavior, mood and personality characteristics in relation to self-reported frequency of traffic citations, accidents and crashes. Finally, the study will explore the relationship between the COVID-19 pandemic and driver fatigue, burnout, and job satisfaction.

Relevance to Strategic Goals

This project will contribute to the two of the USDOT Strategic Goals, namely safety and economic competitiveness. The primary goal will be the **safety** of the employees and the public will be enhanced by the development of an assessment instrument that that can be used to reduce the likelihood of impaired drivers (e.g. as a result of fatigue or sleepiness) operating vehicles. The study will also examine the safety of commercial vehicle drivers during the COVID pandemic when the hours of service rules have been waived. In addition, the **secondary goal will be the increased** economic competitiveness of the transportation system which will be enhanced by developing assessments that could influence or lead to the identification and development of safe drivers which is directly tied to the bottom line of a transportation organization. Decreasing accident injuries and fatalities ensures the safe, ethical operation and economically competitive nature of the system.

The proposed study is also relevant to the strategic goals will also contribute to the transportation industry by contributing to the development of an innovative technology that will improve the Safety and Performance of the Nation's Transportation System. The project will enhance the existing federal effort by **contributing to safety, increasing economic competitiveness** and efficiency, developing the work force and contributing to innovation in the transportation system in the US.

Educational Benefits

Several graduate students will assist with the project thereby contributing to the development and education of graduate students who will later be employed in the industry. These students will gain experience in the data collection techniques commonly used in the transportation industry. In addition, they will gain an understanding of the theory and best practices associated with safety and workforce development.

Technology Transfer

In order to facilitate the technology transfer obtained in the present investigation three separate events will be undertaken.

1. Educational briefing for stakeholders in the immediate project held on the site or the premises of the research sites.
2. A seminar/workshop on the DU Campus with invitees from local DOT and other community agencies to review and discuss key findings.
3. The development of a video and webinar on the findings to be posted on NCIT web page.

Work Plan

Achieving the overarching goal of this project requires the completion of several different tasks. Since the project will be built upon the previous work and studies we anticipate that the results will be a significant contribution to the existing literature. Permission from participating organizations will be needed to gather data from participants.

Task 1 - Literature Review

Review relevant psychological, operational, and experimental studies and papers to determine the measurement of fatigue and alertness relative to transportation safety.

Task 2 – Data Collection

Using online techniques for data collection during COVID to obtain information on fatigue and alertness during work or simulated work times.

Task 3 – Data Analysis

Data will be analyzed to assess the relationship between the various measures, relative to personality, fatigue and driving safety.

Task 4 - Reporting Writing

Draft report will be discussed with stakeholders describing the results of the research and identification of hypothesized linkages.

Task 5 - Stakeholder Feedback

Following the completion of the draft report stakeholders' relevant feedback will be integrated into the report.

Task 6 – Tech Transfer Meetings

The draft report will be shared with stakeholders and relevant findings will be disseminated.

	Months						
Task	1 – 3		4 – 6		7 - 9		10 – 12
1	■	■					
2		■	■				
3				■	■	■	
4					■	■	■
5							■
6							■

Project Cost

Total Project Costs: \$250,000
MPC Funds Requested: \$125,000
Matching Funds: \$125,000
Source of Matching Funds: Predictive Safety, Inc., in-kind support

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