Analyzing ADHD and NonADHD Driver Differences in City vs. Rural Simulated Driving Environments

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Abstract

Motor vehicle crashes are the leading cause of death for younger drivers age 15-20 in the U.S. Researchers have looked extensively at the causes of these crashes. They find, younger drivers are less likely to pay attention to the forward roadway, anticipate a hazard, and have difficulty controlling their driving behaviors. [1,2] While this is true of many young drivers, those with Attention Deficit Hyperactivity Disorder (ADHD) have the additional challenges of increased difficulty with impulsivity, attention, focus and learning challenges. Children diagnosed with ADHD aged 4-17 increased from 9.5% in 2007 to 11% in 2011. [3] Of these, only 4 in 10 are taking medication to treat the symptoms of ADHD. Medication can be effective in helping them navigate the roadway, [4], however these statistics indicate that medication may not be the only intervention required. This research will provide a better understanding of ADHD driver hazard awareness in varying driving environments to specifically target driver training needs.

Drivers were evaluated in the Arbella Human Performance Lab at the University of Massachusetts. A total of 57 participants, aged 16 to 45 took part in this study. Each participant was assigned four randomized drives each containing two hazards, designed to replicate a high-level (city) and low-level (rural) driving environment. Each drive was then blindly scored for a "hit" at the target area, the number of glances and the duration of glances.

Initial findings indicated that drivers with ADHD glance at the target, on average more often than those without ADHD in both environments with and without the cell phone. Both group rates do not show statically significant differences in the HL or LL. However, when given a cell phone task, ADHD drivers have lower hit rates in the LL environment. Additional analysis will be conducted on scanning patterns of individual.

Keywords: Attention Deficit Hyperactivity Disorder (ADHD); driver safety; driving environment; driver engagement

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1. Introduction

Motor vehicle crashes are the leading cause of death for younger drivers age 15-20 in the U.S. Researchers have looked extensively at the causes of young driver crashes and efforts to reduce the reasons for those crashes. They find that younger drivers are less likely to pay attention to the forward roadway, are less likely to anticipate a hazard, and have difficulty controlling their driving behaviors such as speeding. [1,2] While this is true of many young drivers, those that have Attention Deficit Hyperactivity Disorder (ADHD) have additional challenges such as increased difficulty with impulsivity, attention and focus and learning challenges. Children diagnosed with ADHD aged 4-17 continues to increase from 9.5% in 2007 to 11% in 2011. [3] Of these, only 4 in 10 are taking medication to treat the symptoms of ADHD. While medication can be effective in helping younger drivers navigate the roadway, [4], these statistics indicate that medication may not be the only intervention that is required. This research aims to provide a better understanding of ADHD driver hazard awareness in varying driving environments to more specifically target driver training needs for this population.

1.1 Teen Driver Challenges

The latest available data from the National Highway Traffic Safety Administration (NHTSA) [2] indicates that 10.0% of all drivers involved in fatal crashes are between the ages of 15 and 20 whereas drivers in this age group make up a much smaller percentage of the total population of drivers. Research has shown that due to their limited experience, 16 and 17 year old drivers have a significantly higher crash rate than the safest driving cohorts. The most critical period is the first six months after a teenager obtains a driver's license. [5] As a result of these data, teen drivers have become the focus of myriad research efforts attempting to identify the driving attributes, behaviors, and specific scenarios where younger drivers are involved in crashes. Table 1 characterizes existing research focused on young driver crashes. Overall teen drivers are inexperienced, struggle with self-regulation and have developmental and cognitive processing limitations. However, teens with ADHD have additional challenges due to symptoms that affect the way they learn, process information, can be easily distracted and impulsive, have issues around executive functioning of the brain and even greater self-regulation.

Table 1: Overview of Younger Driver Research Attributes and Behavior

Driving Attributes	Driving Behaviors
Teens are less likely to: • pay attention to forward roadway during secondary in-vehicle tasks • anticipate location of unexpected hazards • perform basic vehicle control tasks well like speed control, acceleration, and lane position	Teens are more likely to be involved with crashes with: • speeding • alcohol • passengers • distracting in-vehicle behaviors
[3,6,7,8,9, 10,11,12]	

1.2 Teen Drivers with ADHD Challenges

Looking more closely at ADHD and symptoms related to a diagnosis of ADHD it is apparent that this can impact the way they learn, process information and react. ADHD is reportedly present in 3-7% of school aged children with males being over represented in this group [4,13]. The primary challenges facing these teens are with regard to executive function and decision making. Other cognitive skills are affected by this neurological disorder and behavioral deficits can manifest themselves as outlined in the left panel of Table 2. Not surprisingly, the behavioral deficits associated with ADHD have a specific impact on the skills critical to driving. Difficulties with these skills in turn lead to inflated crash statistics. For example, research suggests that ADHD teen drivers are seven times as likely to have been in two or more crashes and four times as likely to have been at fault for the crash in which they were involved [14].

Table 2: Overview of Applicable ADHD Driver Research

ADHD Symptoms	Driving Impacts
• Distractibility, lack of focused attention • Difficulty in organizing tasks or subject matter • Inability to filter out external stimulus or sensory inputs	• 8 X more likely to lose license • 4 X more likely by involved in a collision • 3 X more likely to sustain serious injury

- 2 to 4X more likely to receive a violation

- Difficulty managing emotions or regulating impulsivity
- Difficulty with accessing working memory or recall
- Difficulty with or processing speed impacts on Driving task

[4,13, 15]

Given the above behavior deficits, teens with ADHD are at a greater disadvantage when learning to drive. A case can be made that the teen ADHD crash statistics are inflated because driving instruction is not targeted towards their particular deficits. Driving is considered a multilevel task that involves skill competency on and across three levels: operational, tactical and strategic. At the operational level, quick responses, attention, concentration, visual scanning, visual-motor integration and spatial perception are required. During the tactical level of a driving task, where executive function is particularly important, a person must learn to anticipate hazards, maintain attention, and mitigate hazards when they do occur. At the strategic level, decisions regarding trip planning, route choice or time of day of travel are required. Any neurological disorders or deficiencies that could affect these three core competencies could negatively impact the driving task [4,18]. ADHD teens struggle with some of these core competency skills required for a successful driving experience.

Looking closer at the ADHD diagnosis can provide some greater details on how this impacts the driving task. To be diagnosed with ADHD a person must meet the diagnostic criteria as outlined in the Diagnostic Something Manual - Version Five (DSM-V). While there are levels of severity in presenting symptoms and combined types of this disorder a Connor's diagnostic rating scale is used to assess symptoms to determine a diagnosis. Symptoms of ADHD must be present across more than one setting including work, home school or other. The three main components of this disorder are inattention, hyperactivity and impulsivity.

The impact on driving performance with ADHD symptoms was presented in a hierarchical graphic figure (Figure 1) and is based on a three-level competency model developed by John Michon's research in a 1979 Dealing with Danger, a technical report. As seen the below figure, the driving task can be comprised of three levels of competency; operational, tactile and strategic. [4,18,19]

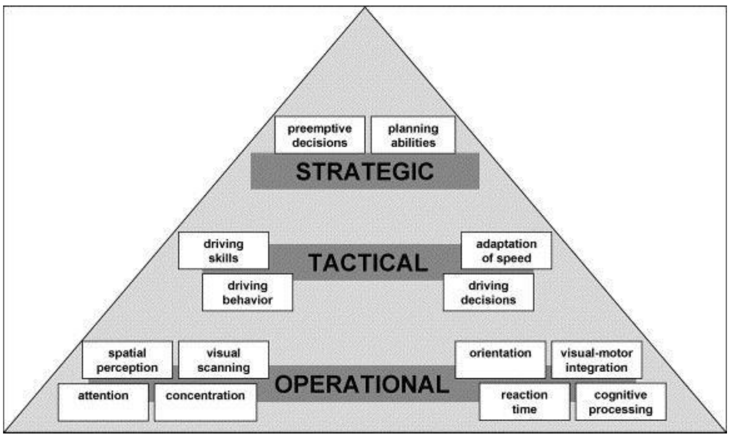

Figure 1: Three-Level Driving Competency Model, [4,18,19]

At the operational level, cognitive functions are required such as; attention, concentration, reaction time, visual scanning, spatial perception and orientation, visual-motor integration, speed of cognitive processing, motor coordination and other neuropsychological abilities that are inherent in driving. [4]
At the tactile level, driver behavior, skills and decisions making are required to drive in traffic, adapt speed and make decisions about passing. [4] Lastly the strategic level requires decision and planning ability relating to the actual route or purpose of the route.

ADHD symptoms can impact the driving task on all of these levels and may present as individuals having difficulty managing or maintain speed, observing traffic lights, in vehicle instruments, distraction by external stimuli such as billboards or work zones and difficulty with sustaining mental effort, such as rural driving environments that require little mental effort. Impulsivity and difficulty following directions can also impact drivers' abilities to regulate their emotions while driving and following safe driving instructions.

1.3 Simulator Studies

In a recent study by Reimer, et al. [20] published in 2009, researchers studied the effects of dual cognitive tasks on young adult drivers with ADHD in a simulated environment. This research focused on identifying potential issues with additional cognitive workload as it relates to the visual task of driving to non-driving tasks. The study group consisted of 63 youth ages 17 to 24 with one year of driving experience, 25 with ADHD and 35 as a control. An important note, of the 25 ADHD subjects, 12 were being treated with stimulant medication at the time of the experiment, but were asked to abstain during the day of the simulation. The participants also received 40$ of compensation for their time in the study and were offered 30$ of incentive money to simulate reward for good driving behavior. The 60$ was portioned out based on the subjects performance on the cognitive task, the ability to avoid traffic violations and collisions, and completing the simulation in less than 45 minutes.

The research was conducted at the Massachusetts Institute for Technology (MIT) Age Lab, using a full-size Volkswagen and STISIM Drive and STISIM Open technology. Participants were evaluated on two to three tasks, the first included a simulated cell phone call to book a dr. appointment and the second was to respond when a target letter was identified over a recorded series of letters. Two driving scenarios were created, the first "high stimulus" driving scenario replicated an urban driving environment while the second, "low stimulus" driving scenario replicated highway driving. The cell phone task was evaluated during the urban driving environment at 35 MPH and the target letter task in the highway portion at 65 MPH.

During the urban portion of the experiment, the ADHD drivers driving performance was comparable to the control group, however they did score significantly lower on the phone task. The ADHD drivers also drove at higher speeds when not involved with a secondary task for a greater distance. In addition, the pause at the stop sign's were significantly higher for the ADHD group before and during the cell phone call. There was increased velocity at each of the stop signs, but this was not different between the groups. The additional time elapsed during the stop sign, while this typically indicates safe driving behavior, can also be indicative of the ADHD drivers having difficulty between driving and the secondary task of letter selection.

The results of the "low stimulus" experiments indicated that the ADHD drivers had difficulty controlling speed, driving over the speed limit for a much greater distance that the control group. There was also indication that speed variability was an issue for both groups, however the ADHD group had a greater difference in the variability of velocity particularly in the "before" and "during" portion of the secondary task. Interestingly, the ADHD subjects actually performed slightly better on the secondary task itself. This is particularly interesting finding, as this type of task (letter recognition) can be given to ascertain attention issues. The researchers suggest in low stimulus environments, it may be more difficult for the ADHD teen driver to maintain focus on the driving task which could result in less responsiveness to sudden changes in the environment or the introduction of a hazard. [20]

In an article published by Classen and Monahan et al. [21]the authors focused on assessing the performance and specific driving errors of teens with ADHD using a driving simulator at the University of Florida. Researchers evaluated 9 teens with diagnosed ADHD and 22 teen controls, all subjects were age 14-18 years and did not yet have a learner's permit or driver's license. Similar to the last study, an OT-CDRS sat in the passenger seat and recorded seven driving errors; lane maintenance, speed regulation, yielding, signaling, visual scanning (displaying scanning of the surrounding environment while driving), adjustment to stimuli, and gap acceptance. The simulator recorded, off-road accidents, collisions, pedestrians, hit, speed exceedances, speeding tickets, traffic light tickets, stop signs missed, centerline crossings, road edge excursions and DA response times. [21] It is important to note, that 6 of the participants were on prescription drugs to treat ADHD during this experiment. The results indicated that the ADHD group performed significantly worse on the clinical testing portion, visual function test, as related to the right eye visual acuity, right peripheral field and selective attention on the UFOV subtest 3 and motor performance measured on the BOT2. These tests relate to Occupational Therapy. However, the simulator data, which represented operational driving functions, did not show any significant difference between the ADHD group and the control group. They assessed that the ADHD group had more visual scanning errors and speed regulation errors, based on observation and the ADHD group made more adjustment to stimuli errors. The response to stimuli errors were measured based on the ability to respond to the driving environment. When you take into the account the clinical testing combined with the simulator findings, the researchers found correlations between speed regulation errors and depth perception. They indicated this was not a surprising finding, as speed regulation is dependent on motor performance, planning, sequencing and selective attention, however they indicate that this requires further investigation. [21]

To date, the research surrounding teens with ADHD has been focused on assessing the fundamental driving deficiencies operationally and tactually. Researchers have found and confirmed that the symptoms of ADHD impact teens driving ability as seen in difficulty in response time to hazards, lane maintenance, speed maintenance and speeding for greater distances in situations where their cognitive functions are split between a secondary task. Secondary tasks are particularly troublesome for this subset of the population and present additional difficulty in distractibility and focus.

1.4 Objective and hypothesis

The objective of this research is to evaluate whether alternative driving environments impact driver abilities to recognize driving hazards with and without ADHD and if the impact of an additional cognitive tasks, cell phone use, has an effect on driver performance.

The three hypotheses are:

Hypothesis 1: ADHD Drivers should be equally engaged as non-ADHD drivers in the HL driving environments.
Hypothesis 2: ADHD Drivers should respond worse to recognizing hazards in the LL driving environments.
Hypothesis 3: ADHD Drivers should perform worse in the HL and the LL driving environment given the additional cognitive task of a cell phone vs no cell phone.

2. Methodology

Drivers with and without ADHD were evaluated in a simulated driving environment in the Arbella Human Performance Lab at the University of Massachusetts. Participants were recruited from the Pioneer Valley in Western Massachusetts from local schools, colleges and through outreach to the communities. A total of 57 participants, aged 16 to 65 took part in this study. Four participants aged 63-67 where removed from the study group as their ages were significantly outside of our cohort groupings. A total of 53 participants were evaluated for this study with approximately half with and without ADHD age range from 16-46. All recruitment materials were approved by the University of Massachusetts Amherst, Institutional Research Board (IRB).

2.1 Driver Measures

Eye tracking was used to evaluate and determine any differences in hazard anticipation, attention maintenance and visual roadway scanning. Two cohorts of drivers, those with and without ADHD were evaluated by scoring a 1 or 0 if the eye tracking crosshairs registered a glance at the dependent variable location or target zone in each drive and for each scenario.

2.2 Participant Procedure

Participants entered the Arbella Human Performance Lab at the University of Massachusetts and were asked to complete a short survey and sign an assent or consent form. Participants under the age of 18 were asked to bring a signed form from their legal guardian. The participant was then given a test drive to complete in the simulator and acclimate to the space. For the experiment, each participant was randomly assigned 4 drives, with each drive containing two hazards, 2 of these drives were assigned a cell phone task to complete. The total participant driving time was 12-14 minutes. Participants were asked to wear an eye tracker in order to monitor their glance location and duration. The eye tracker was fit and calibrated for each participant prior to completing the test drive. Videos were captured of the drivers view on a laptop.

The cellphone task was used in this experiment to create an alternative cognitive task aside from the primary driving task. This type of driving task requires a person to split the cognitive load between driving and a secondary cognitive requirement. The experimenter called the participant at the same point in each drive, 30 seconds into the drive. The questions were then asked in a series over the phone, in order to mimic daily conversations on topics that the participant would not find too complex cognitively.

A sample of these questions were:

- Describe the best thing that happened to you today - in 1 or 2 sentences.
- What time do you usually wake up in the morning?
- What was the last movie you watched? Did you enjoy it?
- Do you have any pets and if so, what are their names and how old are they?
- What are the top 5 places that you would like to visit?
- What is your favorite sports team?
- How did you like the weather today? Why?
- Where did you grow up?
- What is your favorite TV show and character on that show?
- What was your favorite subject in school and why?
- What did you have for lunch? Did you like it?

2.3 Experimental Design Development

Each of the drives was designed to simulate Route 116 in Amherst, Massachusetts with a mix of residential and light business. Two alternative driving environments were designed to simulate a highly engaging roadway and non-engaging roadway. To create levels of engagement in the driving task the roadway geometry was altered from tangent to curves and traffic was included or removed. An engaging or High Level (HL) roadway includes curves requiring lane position navigation, velocity changes and a consistent level of traffic. A Low Level (LL) or non-engaging roadway design is a tangent roadway with no traffic.

Sixteen scenarios were developed to evaluate hazard perception and mitigation. Each of the 8 drives contains at least two hazards. Each of the following 8 hazard scenarios were developed in both the LL and the HL driving environments making a total of 16 randomized scenarios in 8 complete drives of 2-4 minutes. The hazards and drives were randomized using a Latin Square design to avoid any confounding or learning effect that a participant could experience.

Table 3: Hazard Description

Scenario	Description	Dependant Variable
Scenario 1	Intersection Driver to Turn Left and Truck blocking Bike Lane	Driver fixates on left edge of opposing truck at bike lane.
Scenario 2	Truck Blocking Pedestrian Crosswalk – Right	Driver fixates on left front of truck, corner of crosswalk.
Scenario 3	Truck Blocking Pedestrian Crosswalk – Left	Driver fixates on rear edge of truck, corner of crosswalk.
Scenario 4	Lead Vehicle Turning Left and Driver Moving Through Intersection	Driver fixates on rear of lead vehicle.
Scenario 5	Truck Blocking Travel Lane	Driver looks ahead at decoy vehicle as driver pulls out and upstream in the opposing lane
Scenario 6	Stop Sign Ahead/ Stop at Sign	Driver looks at stop sign ahead sign and stops at sign.
Scenario 7	Work Zone Site Obstructed Stop Sign Intersection	Driver looks left in the position of a potential threat vehicle.
Scenario 8	Left Fork in Road with Blind Drive	

3. Analysis

The eye tracker data for each participant was used to evaluate the differences between ADHD and Non ADHD participant groups in a HL and LL environment. Each of the participants drive videos were blindly scored independently by two scorers. Each drive contained three sections of roadway, the first section did not contain a hazard, the second and third section contained hazards. A key location or target area in each hazard scenario was assigned as the target zone or dependent variable. The cross hairs within the video, which were calibrated on the pupil of the participant indicate where the participant glanced and for how long. A glance at the target zone was measured as a "hit" if the glance crossed the dependent variable location. The total number of "hits" was recorded for each participant, for each scenario and categorized by HL or LL with and without a cell phone. The total number of glances and the duration of those glances was also evaluated. The Inter-rater Reliability or IRR score was 78.8%.

3.1 Summary Data

As a preliminary step in the review of data, the average hit rates for the two groups was calculated and compared in the HL and LL environments. This rate was calculated as #of participants hits / total possible hits for the participants LL or HL drives. The rate was then averaged over the total number of participants to observe broad impacts.

As a group, the ADHD cohort appears to perform better when evaluating the hit rates across both the HL and LL environment with and without the cell phone task. (Figure 1, Figure 2) Given the cell phone task, the ADHD cohort and the Non ADHD cohort do decrease performance, although the ADHD cohort still seems to outperform. When you compare the cell phone task in the HL environment between the ADHD cohort and Non ADHD cohort, the performance does not decrease at the same rate between the two groups. (Figure 3)

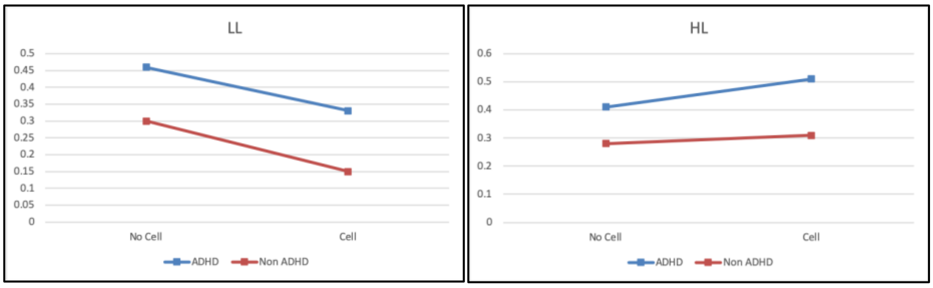

Figure 1: Summary Hits – HL / LL

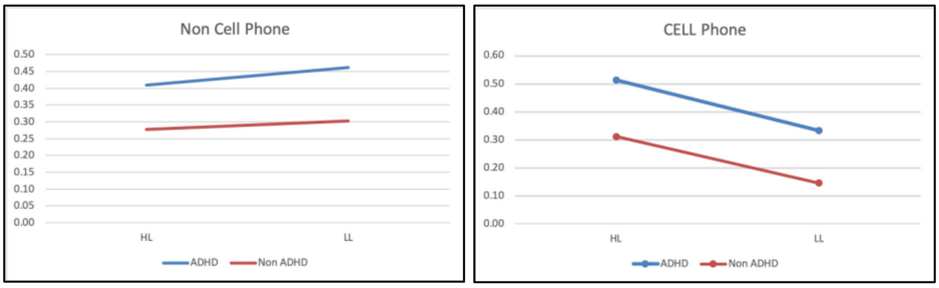

Figure 2: Summary Hits Cell / No Cell

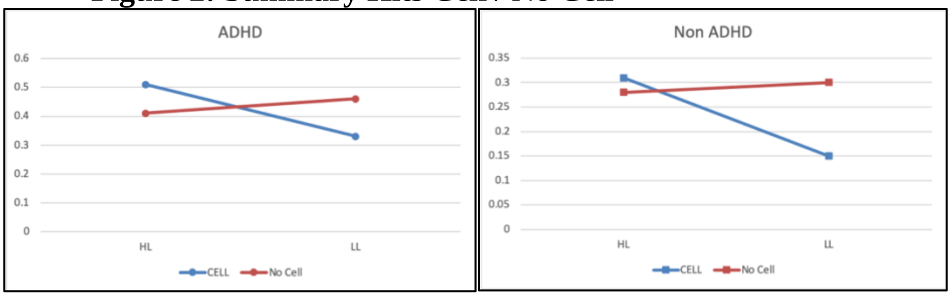

Figure 3: Summary Hits ADHD / Non ADHD

4. Results

The hit rate, number of glances and duration of time of a participant's glances were coded and evaluated for statistical significance.

4.1 Hypothesis 1

The first hypothesis states that we expect the ADHD drivers to be equally engaged as Non ADHD drivers in the HL driving environments. The level of engagement in the HL environment was calculated based on the independent hit rate for each group of drivers. A t-test: Two-Sample Assuming Unequal Variances test was calculated using Microsoft Excel. While we excepted a similar level of engagement with the ADHD cohort in the HL environment as those without ADHD, the ADHD drivers (M=.41, SD =.20) were more engaged that the Non ADHD drivers (M=.28, SD =.16). Given the elements of the roadway, curved and with traffic, there is no statistical significance so we cannot reject the null hypothesis at a .05 alpha, in Table 3 below.

Table 3:ADHD in HL
t-Test: Two-Sample Assuming Unequal Variances

	Adhd	*Non Adhd*
Mean	0.41025641	0.27777778
Variance	0.20273504	0.15619968
Observations	26	24
Hypothesized Mean Difference	0	
Df	48	
t Stat	1.10761655	
P(T<=t) one-tail	0.13677354	
t Critical one-tail	1.6772242	
P(T<=t) two-tail	0.27354707	
t Critical two-tail	2.01063476	

4.1 Hypothesis 2

The second hypothesis states: ADHD Drivers should respond worse to recognizing hazards in the LL driving environments. We compare the hit rates for the ADHD drivers and Non ADHD drivers in the LL environment. A t-test: Two-Sample Assuming Unequal Variances test was calculated using Microsoft Excel.
While we excepted a lower level of engagement in the LL environment, the ADHD drivers (M=.46, SD =.24) were still engaged in the driving tasks compared to the Non ADHD drivers (M=.30, SD =.18). The elements of the roadway were simplified with straight roads and no traffic. There is no statistical significance in the data so we cannot reject the null hypothesis at a .05 alpha in Table 4 below. The hypothesis is accepted, the two groups showed no significant difference in recognizing hazards.

Table 4: ADHD and Non ADHD in LL
t-Test: Two-Sample Assuming Unequal Variances

	Adhd	*Non Adhd*
Mean	0.461538462	0.302777778
Variance	0.238461538	0.178446055
Observations	26	24
Hypothesized Mean Difference	0	
Df	48	
t Stat	1.231967725	
P(T<=t) one-tail	0.111981142	
t Critical one-tail	1.677224196	
P(T<=t) two-tail	0.223962285	
t Critical two-tail	2.010634758	

4.1 Hypothesis 3

The third hypothesis is targeted at identifying the significance between HL and LL environments with the additional cognitive task of using a cell phone. We hypothesized that, ADHD Drivers should perform worse in the HL and the LL driving environment given the additional cognitive task of a cell phone vs no cell phone. A t-test: Paired Two Sample for Means was calculated using Microsoft Excel. While we excepted a lower level of engagement in the ADHD group when given the additional cognitive tasks of conversation on the cell phone in the HL environment, the ADHD drivers performed as well or better as the Non ADHD drivers in recognizing hazards. Using a paired t-test, hit rates, number of glances and the duration of the glances were calculated. As seen in Table 6 and Table 7 the ADHD group performance did not decrease when given the additional cognitive task. There is no statistical significance in the data to indicate that ADHD participants respond differently when they have a cell phone task in a HL or LL environment We reject the hypothesis at a .05 alpha and accept that there is no significant difference.

Table 6: ADHD in HL no Cell/Cell

t-Test: Paired Two Sample for Means

	HL no Cell	*HL Cell*
Mean	0.42666667	0.49333333
Variance	0.20388889	0.20018519
Observations	25	25
Pearson Correlation	0.59901691	
Hypothesized Mean Difference	0	
Df	24	
t Stat	-0.8280787	
P(T<=t) one-tail	0.20789246	
t Critical one-tail	1.71088208	
P(T<=t) two-tail	0.41578492	
t Critical two-tail	2.06389856	

Table 7: ADHD in LL no Cell/Cell

t-Test: Paired Two Sample for Means

	LL no Cell	*LL Cell*
Mean	0.48	0.34666667
Variance	0.23916667	0.20583333
Observations	25	25
Pearson Correlation	0.3298906	
Hypothesized Mean Difference	0	
Df	24	
t Stat	1.21998856	
P(T<=t) one-tail	0.11716113	
t Critical one-tail	1.71088208	
P(T<=t) two-tail	0.23432227	
t Critical two-tail	2.06389856	

5. Discussion

This research examined the difference in ADHD and Non ADHD driving behavior in varying driving environments with and without an additional cognitive tasks. The objective was to evaluate the impact on driver abilities in recognizing hazards. Through our analysis, we discovered that our ADHD group performed better than our Non ADHD group when measuring the hit rate, number of glances and the duration of the glances. The analysis undertaken in this research has highlighted that there are additional variables that require more analysis, prior to drawing conclusions regarding environmental impacts on ADHD driving behavior. While our analysis has resulted in no statistical significance between our data on environment impacts, we did discover a recognized pattern of ADHD participants having a higher number of hit rates than Non ADHD participants in many cases, a higher number of total glances at the target zone and a longer duration of those glances. We noted that the scanning patterns vary among the participants, and will explore scanning patterns of both ADHD and Non ADHD participants to determine if this has an impact on the data.

6. Conclusions

In summary, we evaluated ADHD drivers and Non ADHD drivers in alternative driving environments with and without an additional cognitive task to talk on a cell phone. The ADHD drivers outperformed the Non ADHD drivers across the HL and LL environments with and without the cell phone tasks. In hypothesis 1, we hypothesized that ADHD drivers would be equally engaged in the driving task in the HL environments as the Non ADHD and measured the hit rate. Based on the statistical analysis, we can not reject the null hypothesis and therefor affirm our hypothesis that they did in fact drive equally as well based on the hit rate. In the second hypothesis we proposed that ADHD drivers should respond worse in the LL environment, however they did not. ADHD drivers again did as well in the HL and LL environments when compared to performance on hit rates, we must reject our hypothesis. In the last analysis we evaluated the ADHD drivers in the HL and LL environments with and without the additional cognitive task of using a cell phone. Again, the ADHD drivers did well, although there is a slight decrease in the hit rate in the LL environments, there is no statistical significance and we must reject our hypothesis. While the ADHD group appeared to outperform the Non ADHD group in many of these analysis, a pattern was recognized by the researchers in the scanning pattern differences of the drivers. Participants with varying scanning patterns could result in higher hit rates when scoring. The researchers next steps will be to evaluate each participants visual glance scanning patterns to validate these results and provide another level of analyses.

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