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

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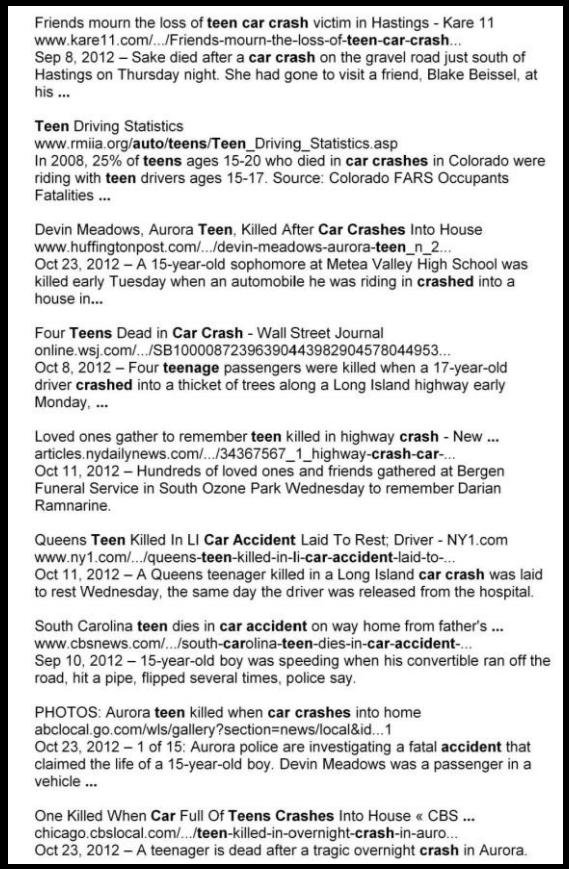
Leading Cause of Teen Deaths (US)

Teen Crash Rates

- Over 42,915 fatal crashes/yr
- 10% of all fatal crashes involve drivers aged 15-20
- Leading cause of death in the 15-18 age group
- Research shows that teens between 16-17 yrs old, have limited driving experience and can be more easily distracted



Friends mourn the loss of **teen car crash** victim in Hastings - Kare 11
www.kare11.com/.../Friends-mourn-the-loss-of-**teen-car-crash**...
Sep 8, 2012 – Sake died after a **car crash** on the gravel road just south of Hastings on Thursday night. She had gone to visit a friend, Blake Beissel, at his **...**

Teen Driving Statistics
www.rmiia.org/**auto/teens/Teen**_Driving_Statistics.asp
In 2008, 25% of **teens** ages 15-20 who died in **car crashes** in Colorado were riding with **teen** drivers ages 15-17. Source: Colorado FARS Occupants Fatalities **...**

Devin Meadows, Aurora **Teen**, Killed After **Car Crashes** Into House
www.huffingtonpost.com/.../devin-meadows-aurora-**teen**_n_2...
Oct 23, 2012 – A 15-year-old sophomore at Metea Valley High School was killed early Tuesday when an automobile he was riding in **crashed** into a house in**...**

Four **Teens** Dead in **Car Crash** - Wall Street Journal
online.wsj.com/.../SB10000872396390443982904578044953...
Oct 8, 2012 – Four **teenage** passengers were killed when a 17-year-old driver **crashed** into a thicket of trees along a Long Island highway early Monday, **...**

Loved ones gather to remember **teen** killed in highway **crash** - New **...**
articles.nydailynews.com/.../34367567_1_highway-**crash-car**-...
Oct 11, 2012 – Hundreds of loved ones and friends gathered at Bergen Funeral Service in South Ozone Park Wednesday to remember Darian Ramnarine.

Queens **Teen** Killed In LI **Car Accident** Laid To Rest; Driver - NY1.com
www.ny1.com/.../queens-**teen**-killed-in-li-**car-accident**-laid-to-...
Oct 11, 2012 – A Queens teenager killed in a Long Island **car crash** was laid to rest Wednesday, the same day the driver was released from the hospital.

South Carolina **teen** dies in **car accident** on way home from father's **...**
www.cbsnews.com/.../south-**car**olina-**teen**-dies-in-**car-accident**-...
Sep 10, 2012 – 15-year-old boy was speeding when his convertible ran off the road, hit a pipe, flipped several times, police say.

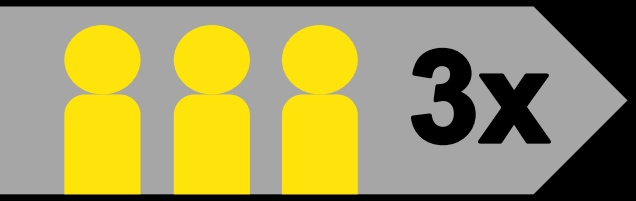
PHOTOS: Aurora **teen** killed when **car crashes** into home
abclocal.go.com/wls/gallery?section=news/local&id...1
Oct 23, 2012 – 1 of 15: Aurora police are investigating a fatal **accident** that claimed the life of a 15-year-old boy. Devin Meadows was a passenger in a vehicle **...**

One Killed When **Car** Full Of **Teens Crashes** Into House « CBS **...**
chicago.cbslocal.com/.../**teen**-killed-in-overnight-**crash**-in-auro...
Oct 23, 2012 – A teenager is dead after a tragic overnight **crash** in Aurora.

Source: NHTSA, 2021
McCartt, AT, Shabanova, VI and Leaf, WA, Driving experience, crashes and traffic citations of teenage beging drivers 2003
Google Search : Teen Crashes

Teen Drivers with ADHD

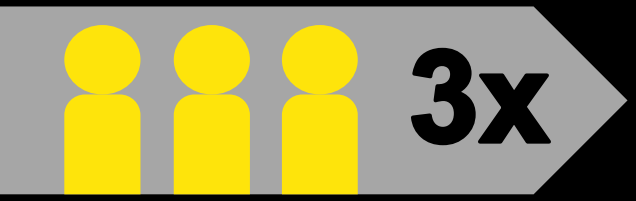
Compared to teens without ADHD



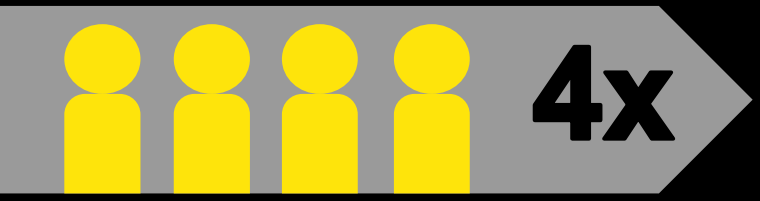
SERIOUS INJURY

Teen Drivers with ADHD

Compared to teens without ADHD



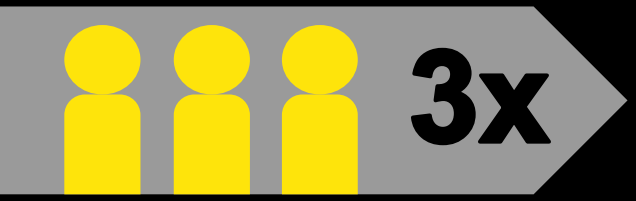
SERIOUS INJURY



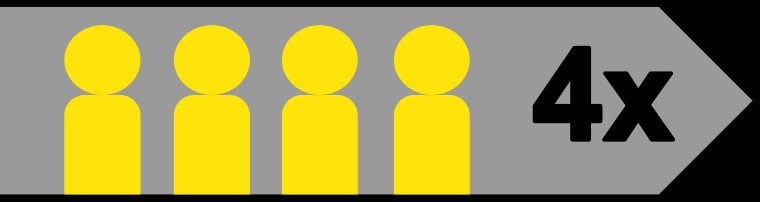
COLLISION

Teen Drivers with ADHD

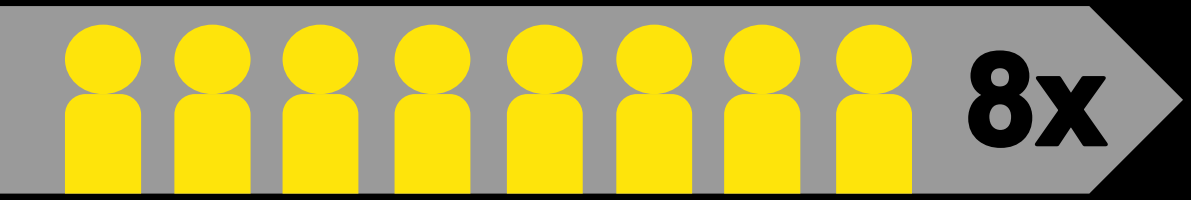
Compared to teens without ADHD



3x SERIOUS INJURY



4x COLLISION



8x LOSE LICENSE

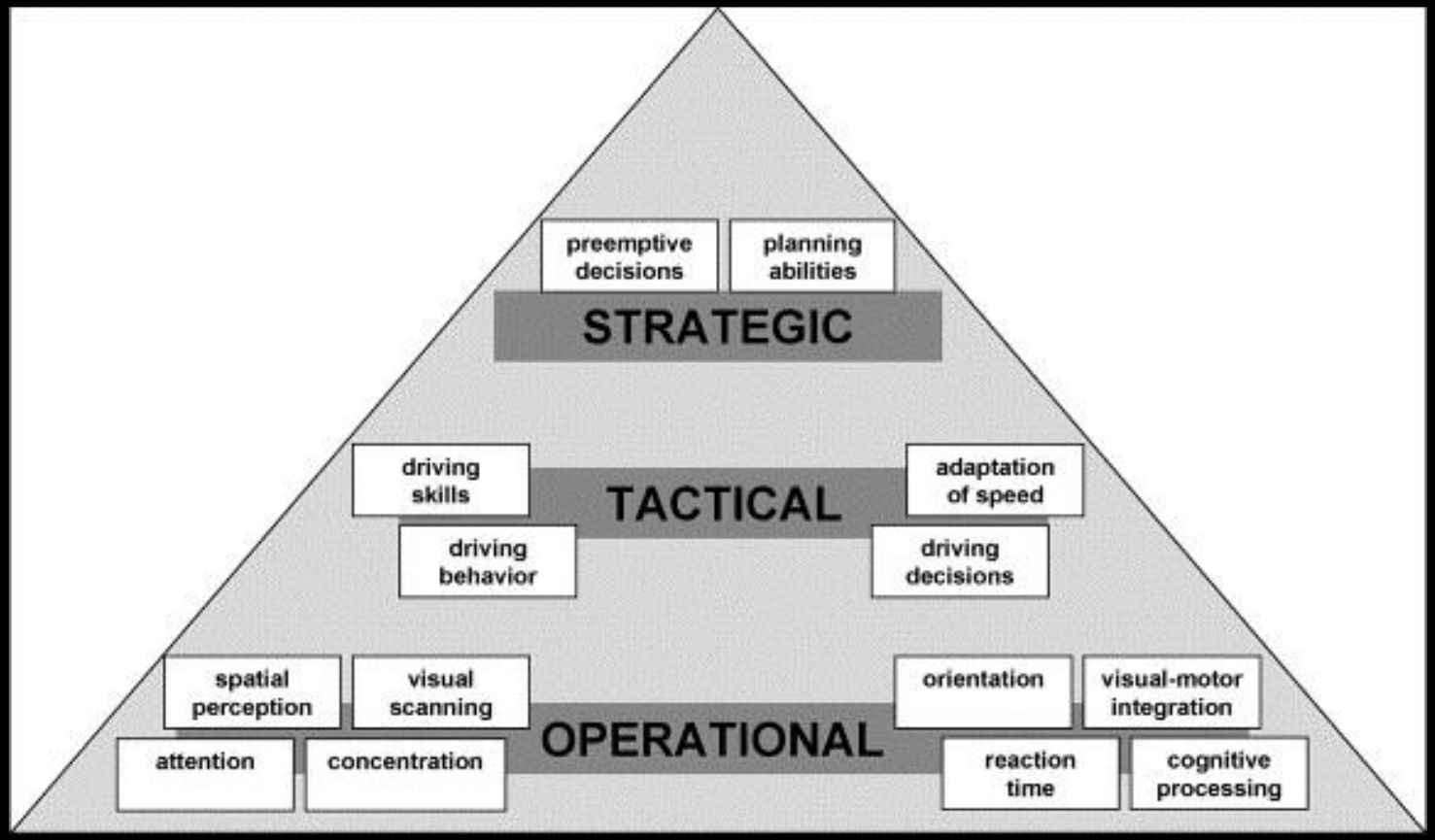

WHY?

Symptoms of ADHD

- Distractibility, lack of focused attention
- Difficulty in organizing tasks or subject matter
- Inability to filter out external stimulus or sensory inputs
- Difficulty managing emotions or regulating impulsivity
- Difficulty with accessing working memory or recall
- Difficulty with or processing speed

DSM-V, Barkely et. al 2002

Symptoms of ADHD



Source: Association of driving with the 3 hierarchical levels of competency - operational, tactical, and strategic. - Russell A. Barkley Daniel Cox – A review of driving risks and impairments associated with attention-deficit/hyperactivity disorder and the effects of stimulant medication on driving performance - Journal of Safety Research Volume 38, Issue 1 2007 113 - 128

Literature

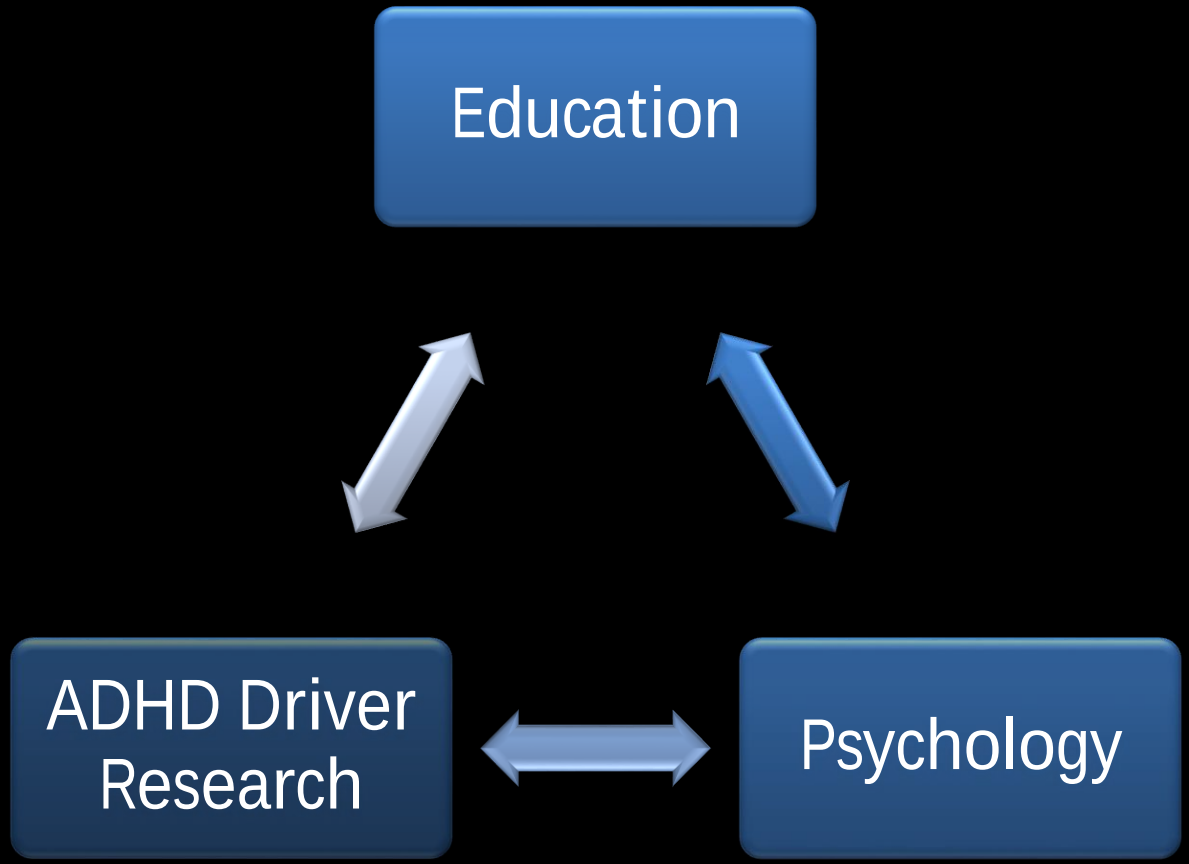
	Fischer 20	Barkley 1996	Barkley 2002	Narad	Reimer 2008	Monanhan 2013	Michaelis	Paciulli 2017
Simulator- Desktop	X	X					X	
Simulator- Full Size				X	X	X		X
Eye Tracker							X	X
Driving History- Self reported	X		X		X			X
Driving History- Motor Vehicle Record	X		X					
Driving Performance / Operation	X	X	X	X	X	X		X
In Vehicle Observations						X		
Secondary Tasks	X			X	X			X
Hazard Anticipation				X	X			X
Hazard Mitigation				X	X			X
Attention Maintenance				X	X			X

Phases I & II

1. Evaluate Drivers with and without ADHD in Different Driving Environments to Determine Differences

2. Develop a Game-Based Online Driver Training Program Focused on ADHD Learner Needs

Research Framework



Phase I: Demographics

- 55 Participants
  - 20 Male / 36 Female
  - Approximately 48% ADHD in Each Cohort

Cohort	#	M	F	ADHD M	ADHD F
16-20	**30**	**13**	**17**	**7**	**8**
21-67	**26**	**7**	**18**	**3**	**9**

Phase I: Survey Results

- Age 16-20 Cohort ADHD Participants
  - 40% Crash 6 Month - 2 Years
  - 23% Traffic Violation Last Year

- Age 21-45 Cohort ADHD Participants
  - 67% Crash 1-2 Years
    - **2 Male Participants had >5 Crashes !!**
  - 23% Traffic Violation Last Year

Drive Development

- RTI Simulator with the Eye Tracker
- Environmentally Designed as Route 116
- 8 Unique Hazards with varying driving conditions
  - High Level of Stimulus (HL) City
  - Low Level of Stimulus (LL) Rural
- Total of 16 Scenarios

Drive Development Detail

- City / High Level of Stimulus (HL)
  - Curved Roadway Geometry
  - Moderate Level of Traffic
- Rural / Low Level of Stimulus (LL)
  - Straight Roadway
  - No Traffic

UMass Arbella
Human Performance Lab

Hazard Example

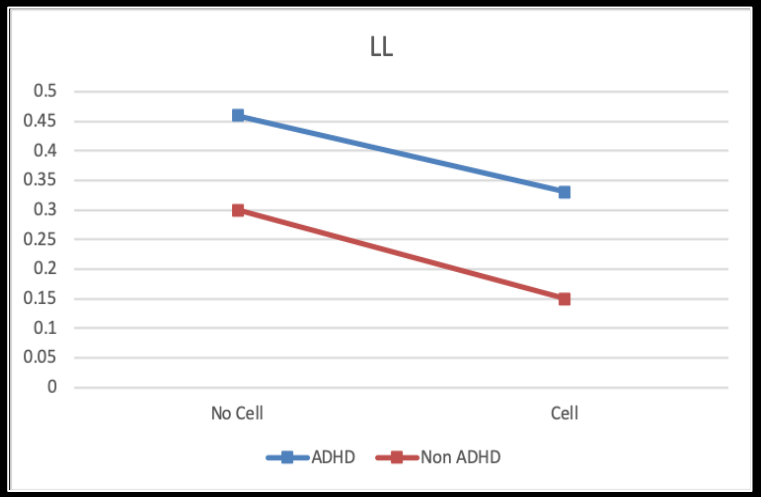
Experiment Phase I

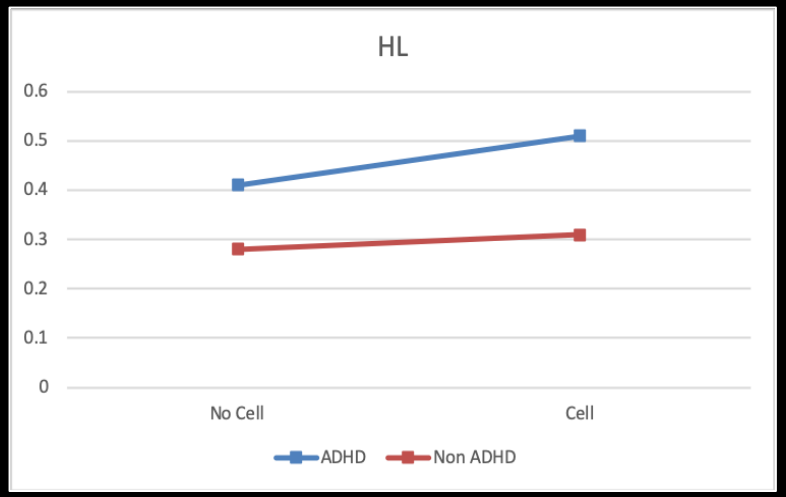
- IRB approval
- Each participant signs consent/assent
- Pre Survey
- Eye tracker fit and calibrate
- Practice drives to acclimate
- 4 drives 2-3 minutes per drive
- Post Survey

Results

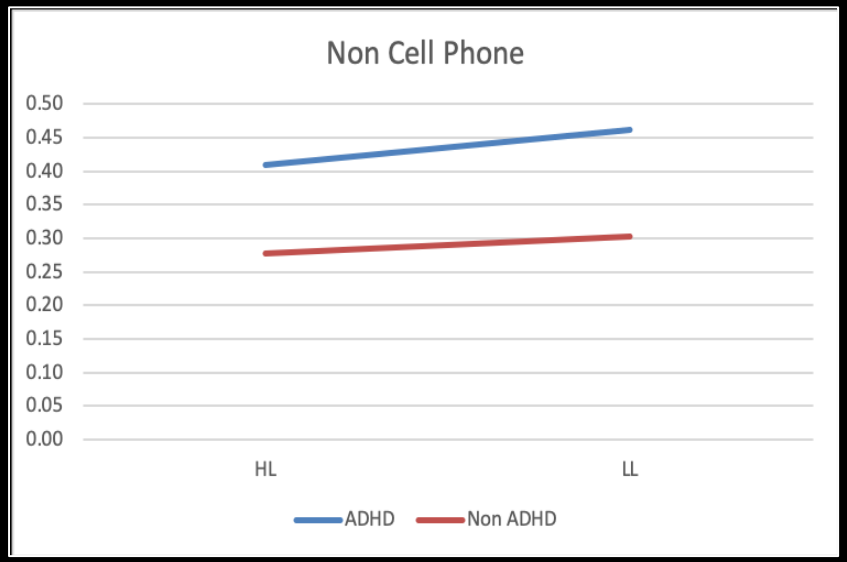
- Hit Rates
  - Did our participants glance at the dependent variable location in our hazard scenarios
- Number of Glances
  - How many times did participants glance at the dependent variable location
- Duration of Glances
  - The total time in seconds that participants looked at the duration of the dependent variable

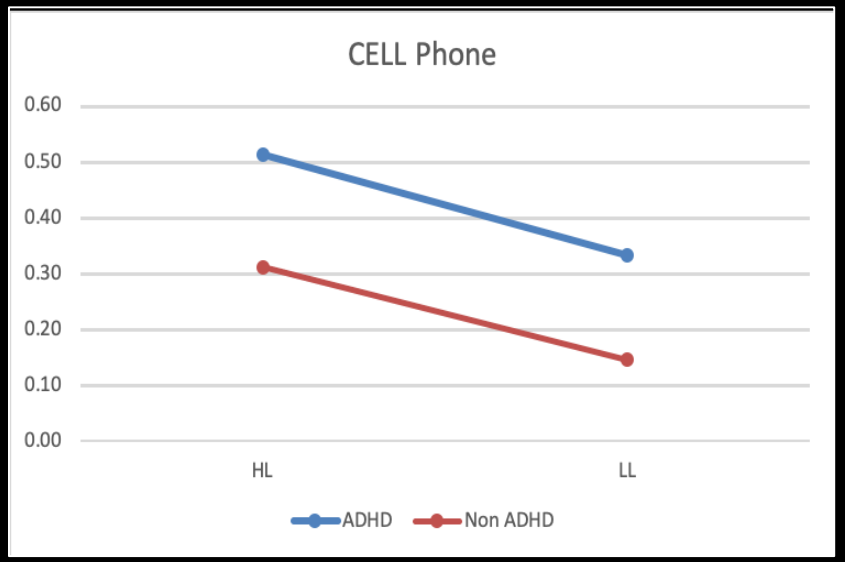
Summary Hits – HL / LL



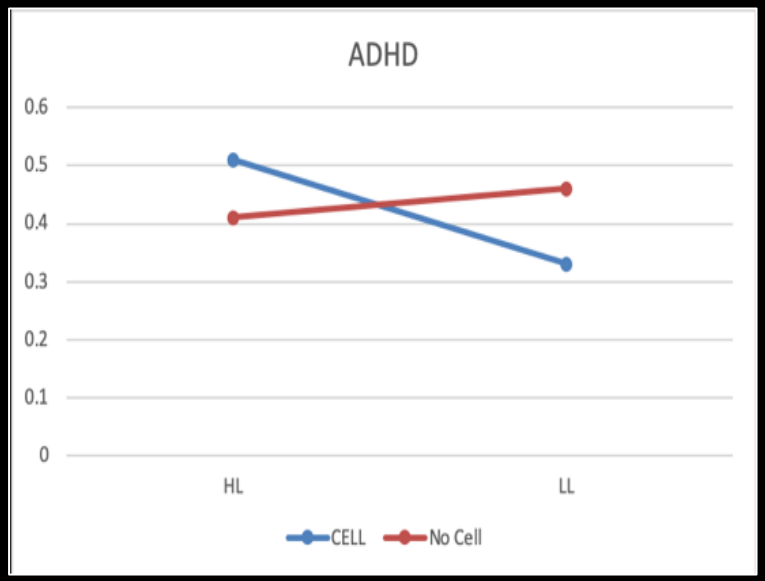


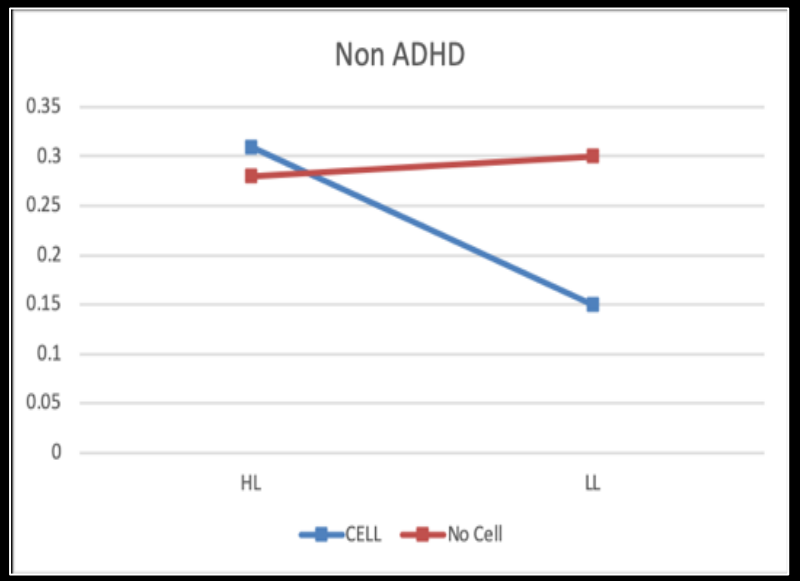
Summary Hits Cell / No Cell





Summary Hits ADHD / Non ADHD





Hypothesis

1. ADHD drivers should be equally engaged as non-ADHD drivers in the HL driving environments.

2. ADHD drivers should respond worse to recognizing hazards in the LL driving environments.

3. ADHD drivers should perform worse in the HL and the LL driving environment given the additional cognitive task of using a cell phone.

Hypothesis #1

ADHD drivers should be equally engaged as non-ADHD drivers in the HL driving environments.

- t-test Two-Sample Assuming Unequal Variance
- ADHD were more engaged (M =.41, SD = .20)
- Non- ADHD drivers (M=.28, SD = .16)
- Alpha .05
- Not statistically significant
- Reject the hypothesis

Hypothesis #2

ADHD drivers should respond worse to recognizing hazards in the LL driving environments.

- t-test Two-Sample Assuming Unequal Variance
- ADHD were equally engaged (M =.46, SD = .24)
- Non- ADHD drivers (M=.30, SD = .18)
- Alpha .05
- Not statistically significant
- We can not reject the null
- Accept this hypothesis

Hypothesis #3

ADHD drivers should perform worse in the HL and the LL driving environment given the additional cognitive task of using a cell phone.

- Paired t-test Two-Sample for Means
- ADHD performance did not decrease
- Alpha .05
- Not statistically significant
- We reject this hypothesis

Thoughts on Results

- Why are our ADHD group out performing or equally performing to our Non-ADHD group?
- Throughout scoring, we noticed that the drivers had very different scanning patterns
- Does this different scanning pattern inflate our hit rate?

Conclusion

- Our ADHD and Non- ADHD drivers did not differ greatly in their response to City (HL) or Rural (LL) environments with and without the cell phone task
- In fact the ADHD group seemed to out perform the Non-ADHD group
- Is this due to comorbid ADHD symptoms, hyperactivity, impulsivity
- Deeper dive is necessary to understand driver scanning differences in two groups
- These results inform Phase II – The development of a specialized e-learning ADHD Driver Training Program, **DrivingMyADHD**

Questions?

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DRIVING ADHD