DISTRACTED DRIVING & IMPAIRED DRIVING

BEHAVIORAL ANALYSIS

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SAFETY AND BEHAVIORAL ANALYSIS (SABA) CENTER

HTTPS://WWW.YOUTUBE.COM/WATCH?V=VSKFGXWMGD0

TRAFFIC SAFETY ACTIVITIES

- Distracted Driving
  - Hands on Wheel, Eyes on Road Campaign
  - The Effect of In-Vehicle Distractions (Cellphone, Eating/Drinking, Clothing) on Driving Performance
  - The Effect of Out-of-Vehicle Distraction (Billboards) on Driving Performance
  - Developing a Distracted Driving Recognition Model (AI - Machine Learning)
  - Distracted Driving Prevention Using CAV
  - Impaired Driving

HANDS ON WHEEL, EYES ON ROAD CAMPAIGN

- Produced 2 videos
  - https://www.youtube.com/watch?v=G9LHRAUrCyo&t=4s
  - https://www.youtube.com/watch?v=PwX-MQQud-U&t=5s
- Distributed
  - YouTube
  - Email lists
  - Website/Twitter/Facebook
  - Colleges, Universities, High schools, and Driving Schools

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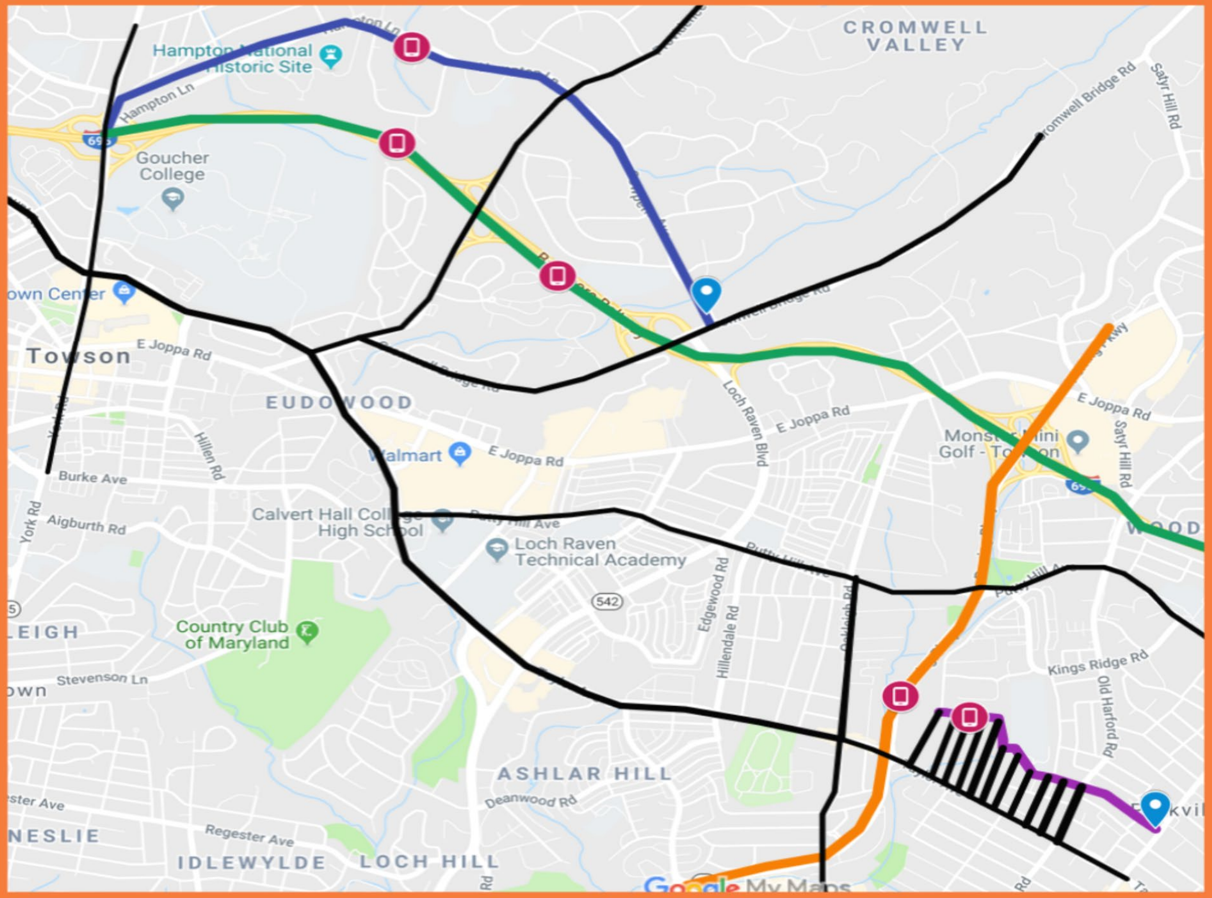
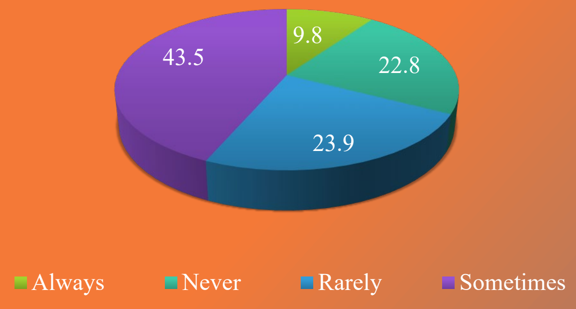
THE EFFECT OF IN-VEHICLE DISTRACTIONS ON DRIVING PERFORMANCE

- 92 Participants
- 4 road types
- 6 Distractions
  - Hand-held calling
  - Hands-free calling
  - Texting
  - Voice command
  - Clothing
  - Eating/drinking

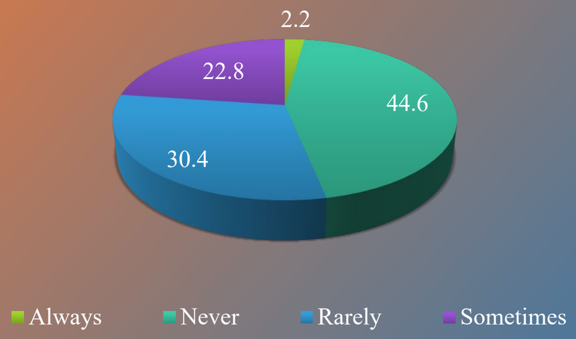


Pre-simulation Surveys Responses

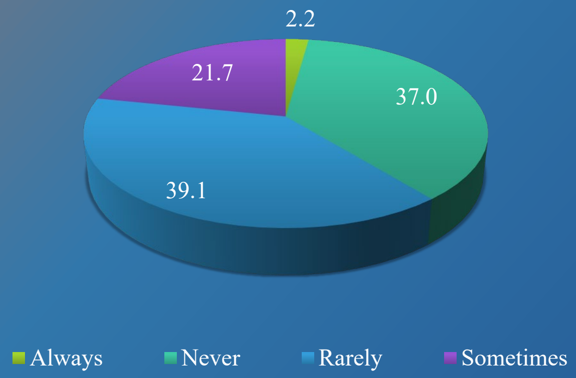
Talk On The Phone (Hands Free) While Driving



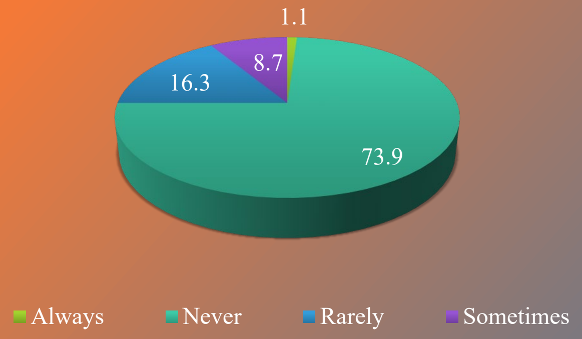
Talk On The Phone (Hand-Held) While Driving



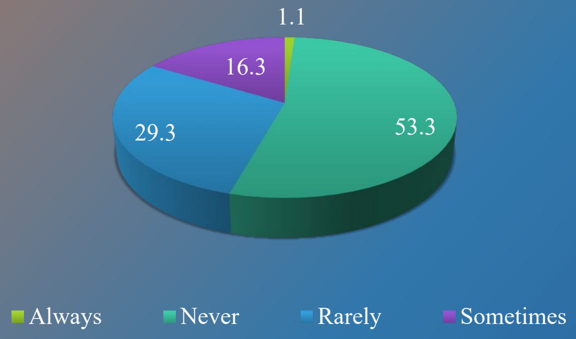
Texting While Driving



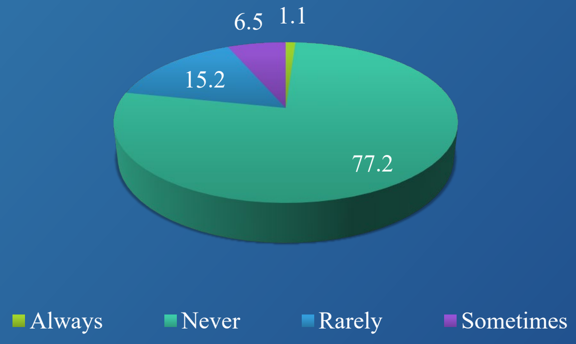
Read/Update Social Media While Driving



Take Pictures/Record Video While Driving



Read/Respond To Emails While Driving



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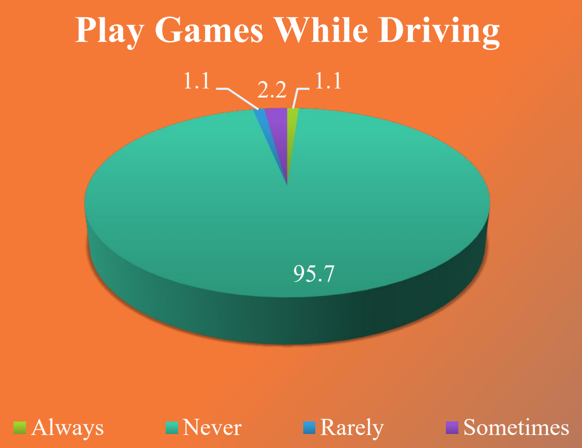
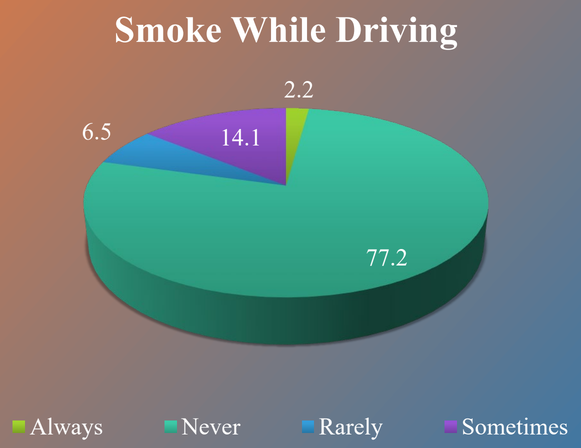
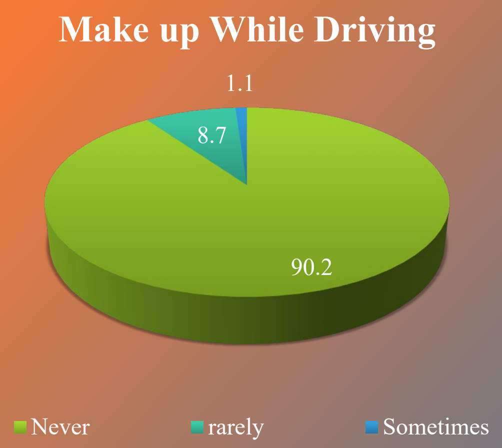
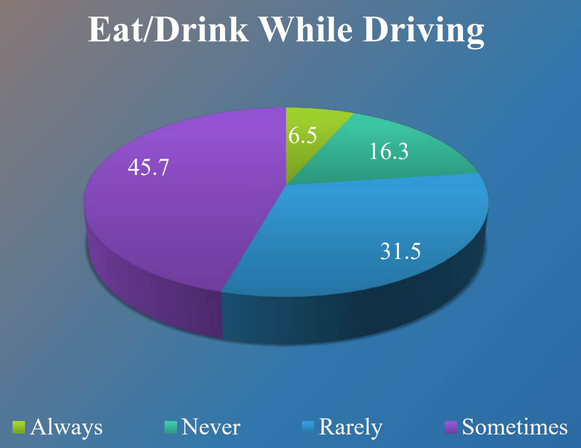
Pre-simulation Surveys Responses

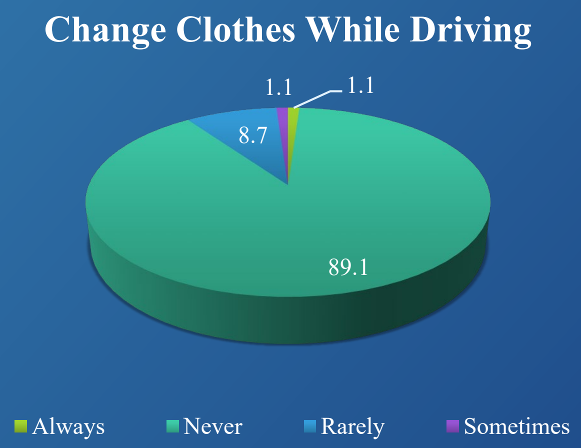

Play Games While Driving


Smoke While Driving

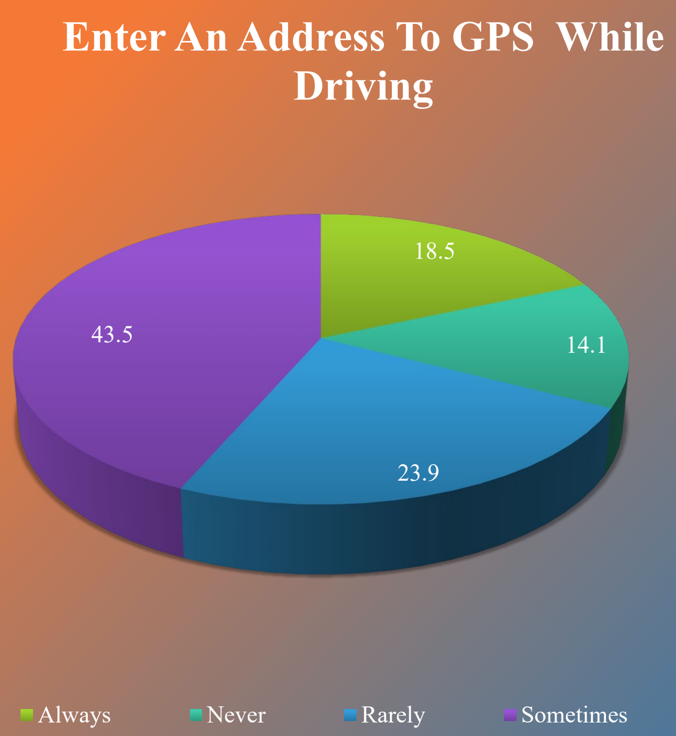

Shave While Driving

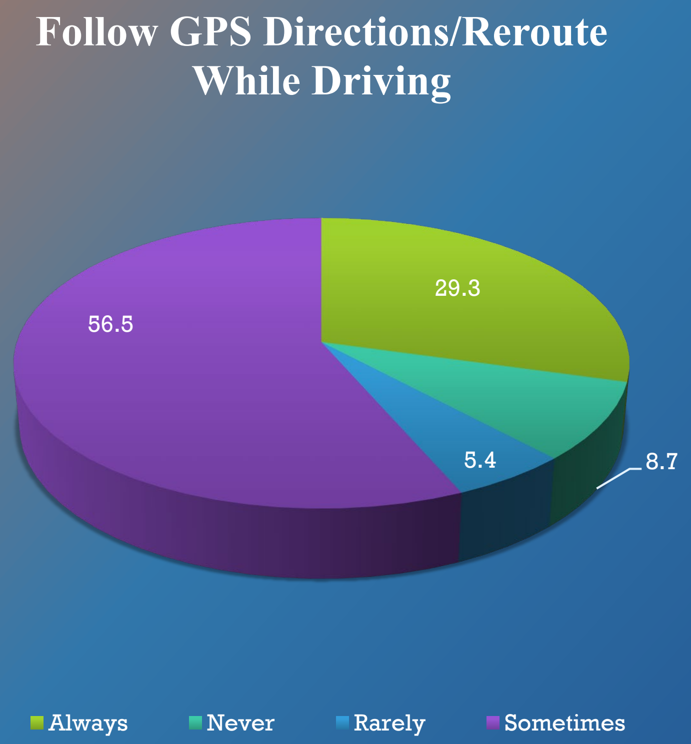

Make up While Driving


Eat/Drink While Driving


Change Clothes While Driving

Pre-simulation Surveys Responses

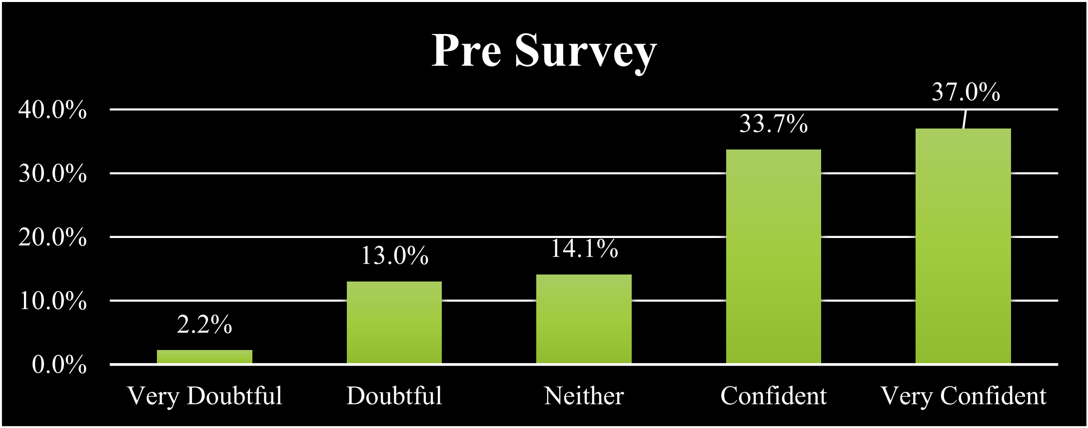


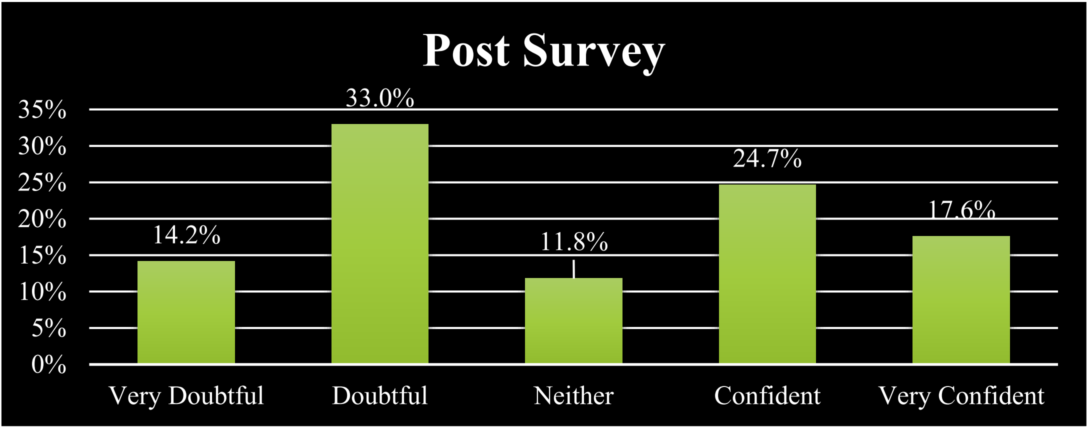


Post-simulation Surveys responses:

To what extent are you confident that YOU, driving in following situations, would NOT experience any driving mistakes such as deviating from the destination, going through a red light, near-crash experience, crash, etc.?

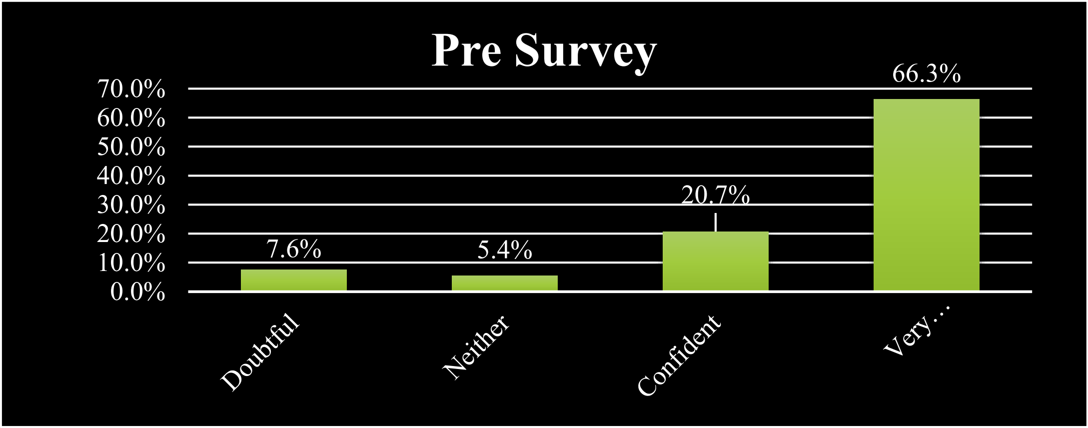
Technologies such as voice to text

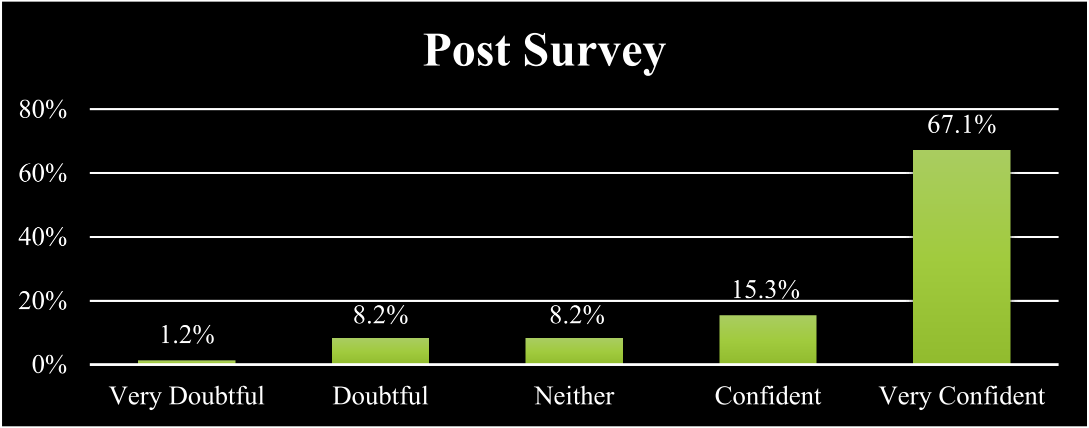

Pre Survey


Post Survey

To what extent are you confident that YOU, driving in following situations, would NOT experience any driving mistakes such as deviating from the destination, going through a red light, near-crash experience, crash, etc.?

No cell phone

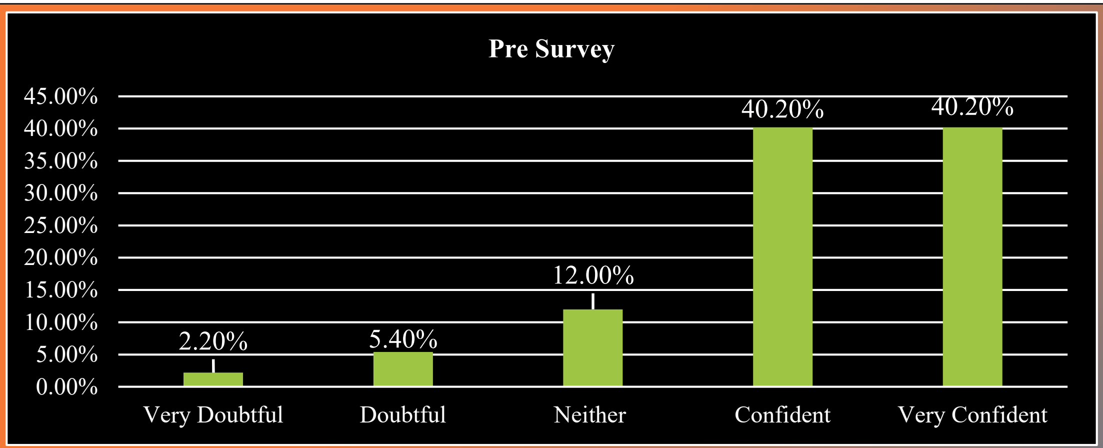

Pre Survey

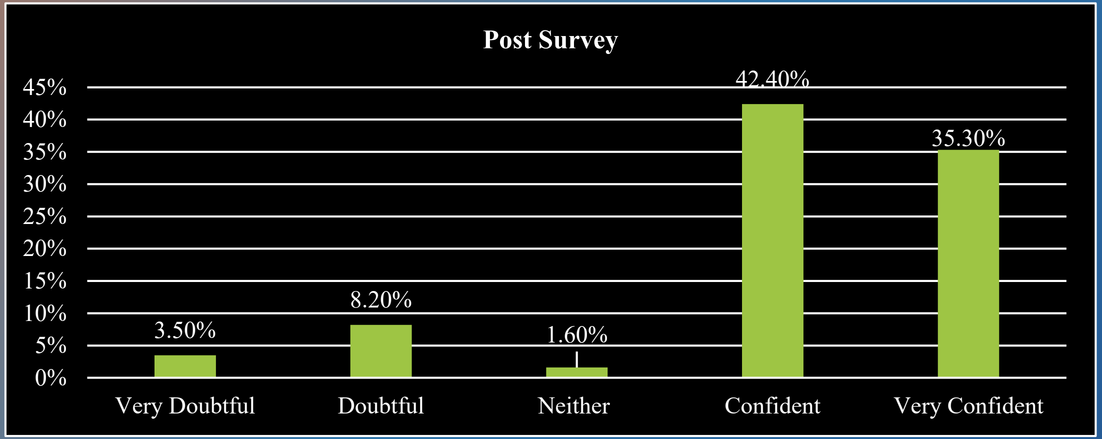

Post Survey

Post-simulation Surveys responses:

To what extent are you confident that YOU, driving in following situations, would NOT experience any driving mistakes such as deviating from the destination, going through a red light, near-crash experience, crash, etc.?

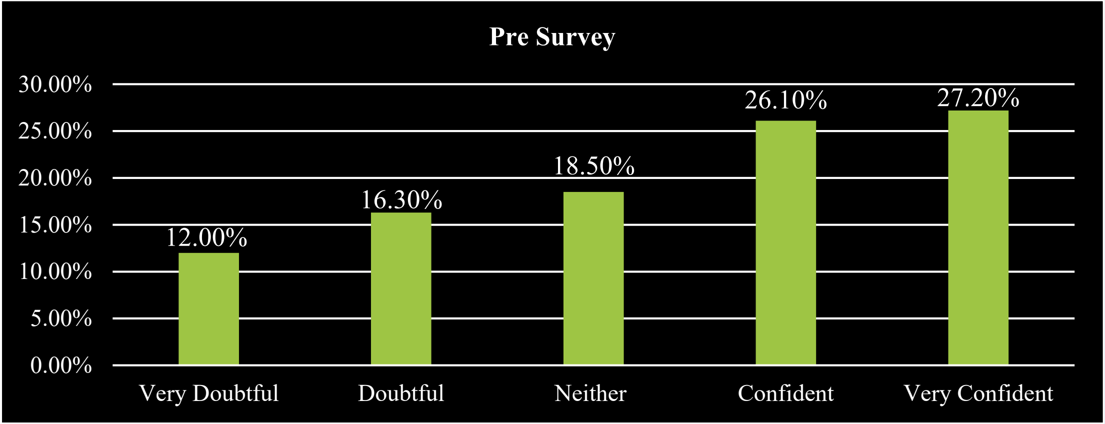
Using accessories such as headsets

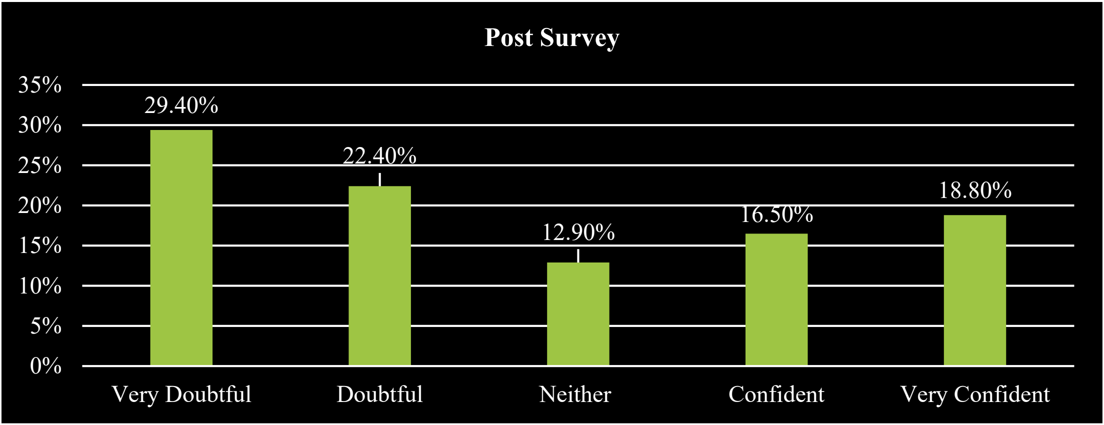

Pre Survey


Post Survey

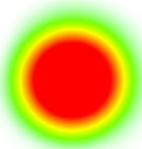
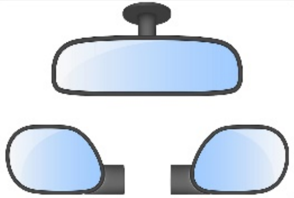
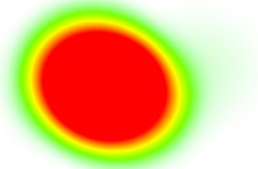
To what extent are you confident that YOU, driving in following situations, would NOT experience any driving mistakes such as deviating from the destination, going through a red light, near-crash experience, crash, etc.?

Hand-held cell phone

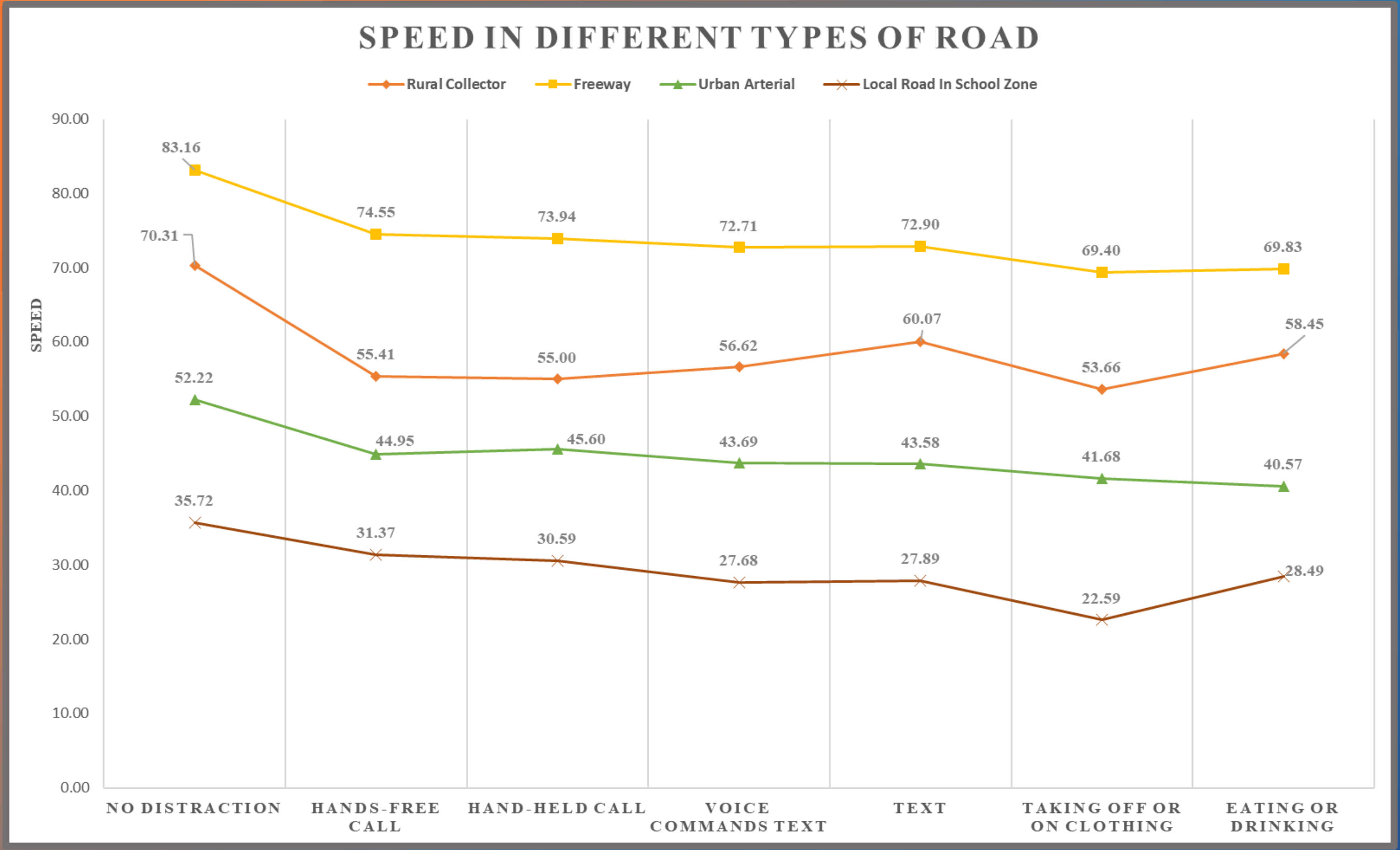

Pre Survey


Post Survey

In-Vehicle Distractions Eye-Tracking Analysis

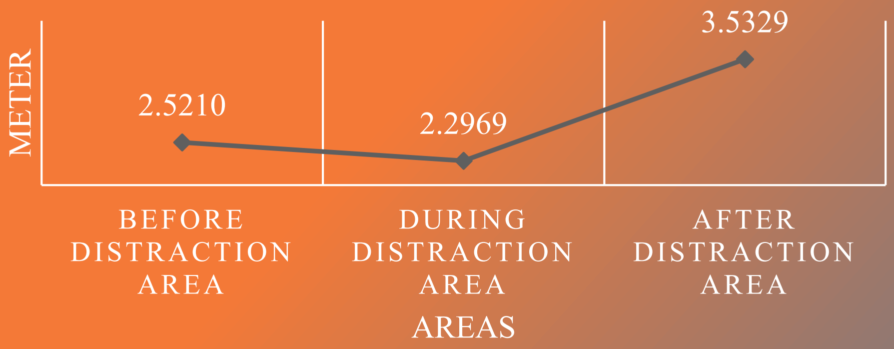
Gaze Points		Heat Map	Percentage
Phone			32.19%
Rearview Mirror			2.43%
Speedometer			0.86%
Road			61.52%
Road Signs			2.15%
Off Screen			0.86%

DRIVING SIMULATOR

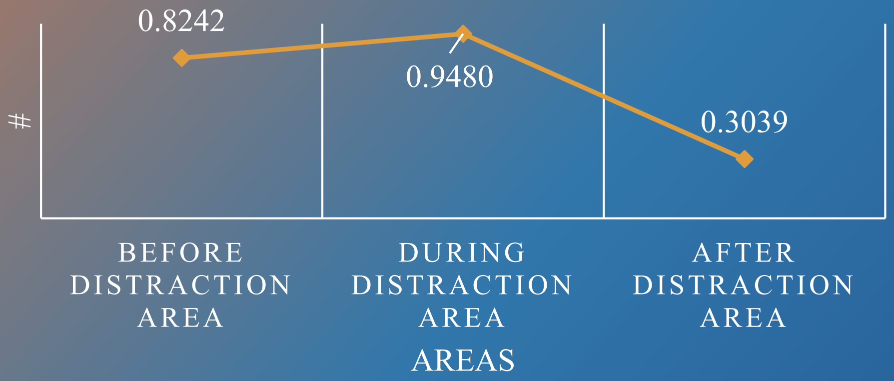


Drivers' Performance, Descriptive Analysis:

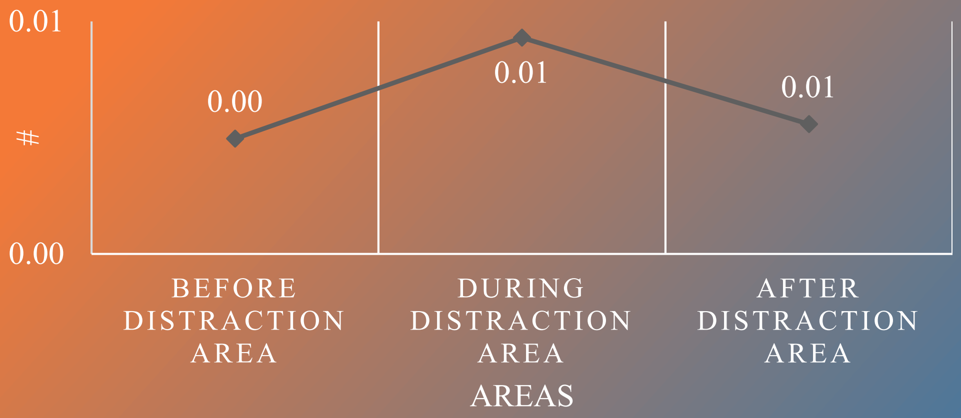
AVERAGE OFFSET FROM LANE CENTER



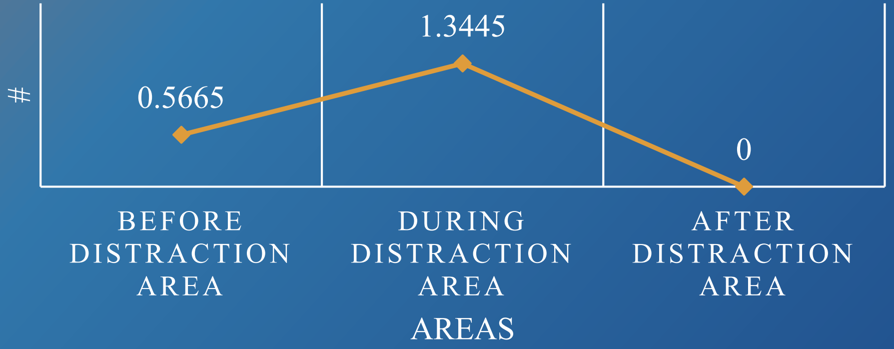
AVERAGE LANE CHANGE



AVERAGE COLLISION

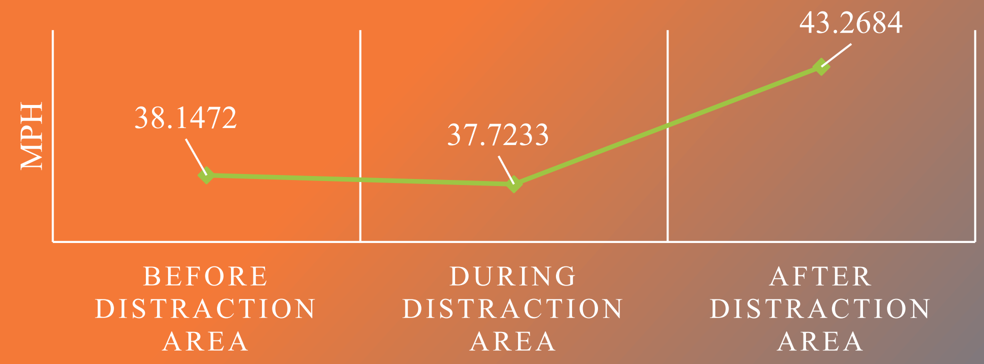


AVERAGE BRAKE LIGHT

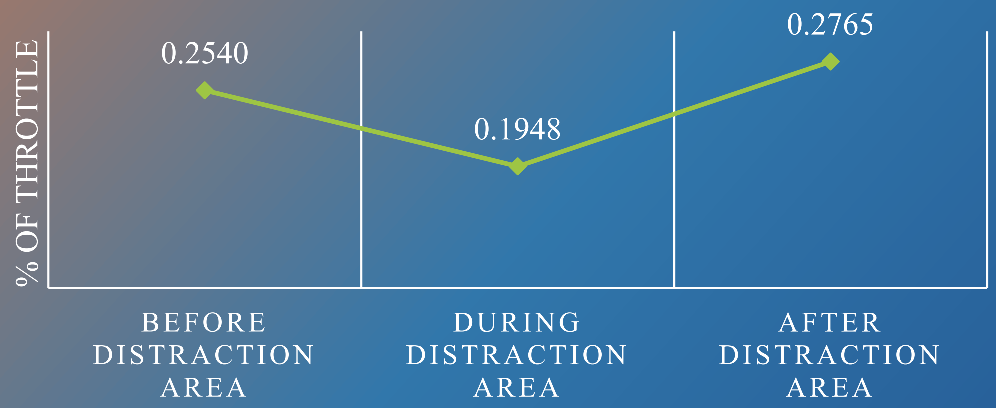


Drivers' Performance, Descriptive Analysis:

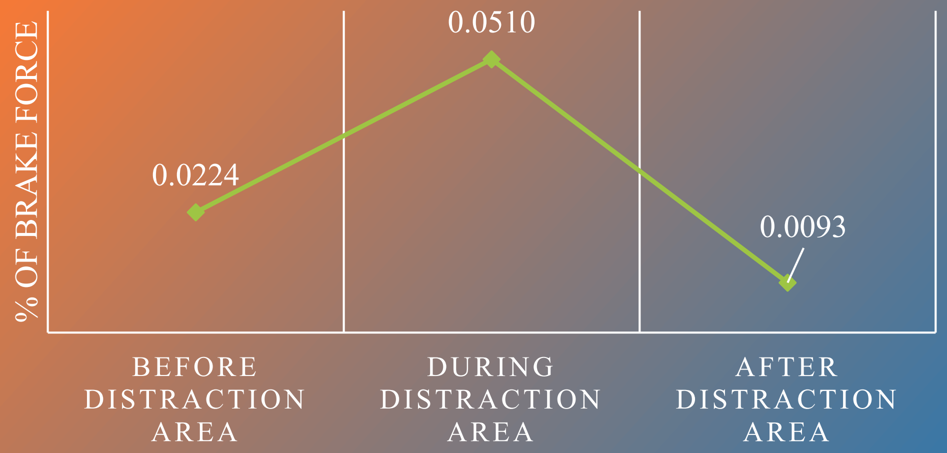
AVERAGE VEHICLE SPEED



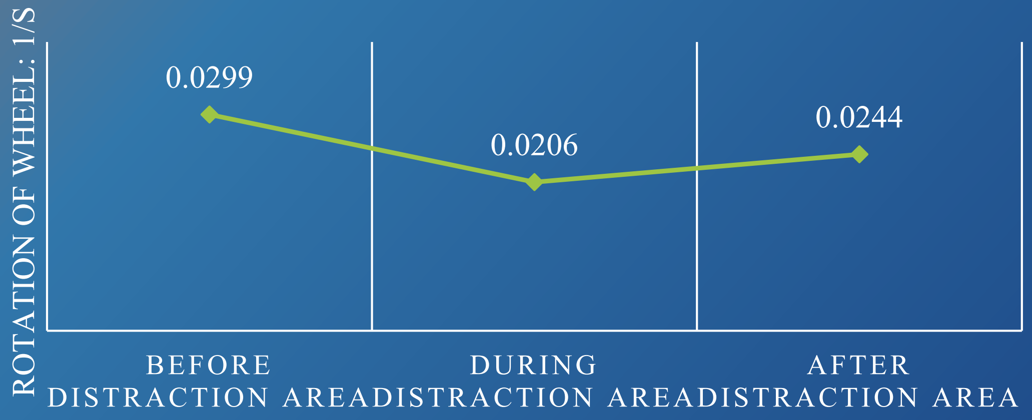
AVERAGE THROTLE



AVERAGE BRAKE



AVERAGE STEERING VELOCITY



FINDINGS

- The Most Common Distractive Activities
  - Entering an Address in GPS
  - Eating/Drinking
  - Hands-Free Calling
  - Texting
  - Handheld Calling

FINDINGS

- Participants decreased their speed while distracted in all distractions
- The highest speed reduction happened on the local road when taking on/off clothing (50%),
- then voice command texting (33%),
- and then texting (29%).
- In general, speed reduction was the highest on the local road.

FINDINGS

- Participants applied the brakes more often and more forcefully when distracted
- Steering velocity increased on the ***freeway*** for ***all*** distractions
- Steering velocity increased in ***eating/drinking*** distractions on ***all roads***
- Offset from the center of the lane increased dramatically when ***taking on/off clothing*** and ***eating/drinking***, especially on the freeway (about 70%).

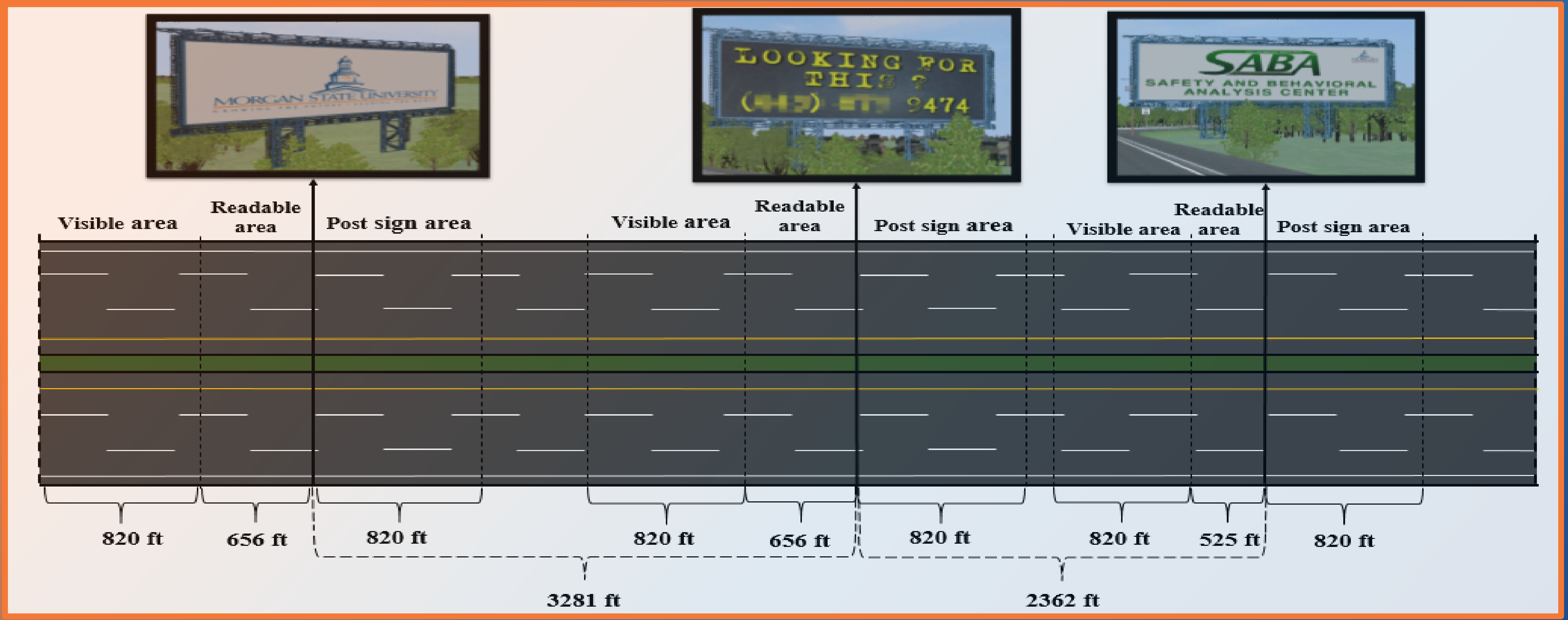
FINDINGS

- ***Texting*** has the highest percentage of eyes off the road.
- Text messages with a higher cognitive load demanding a response have a ***24%*** higher fixation duration and frequency
- Text messages with a higher cognitive load increase the distraction time by ***14%***
- Male participants were less distracted than female drivers, i.e., their gaze fixations were more on the road than the phone, compared to female participants.
- The older (26-35) participants were found to be less distracted than the younger participants (18-25).

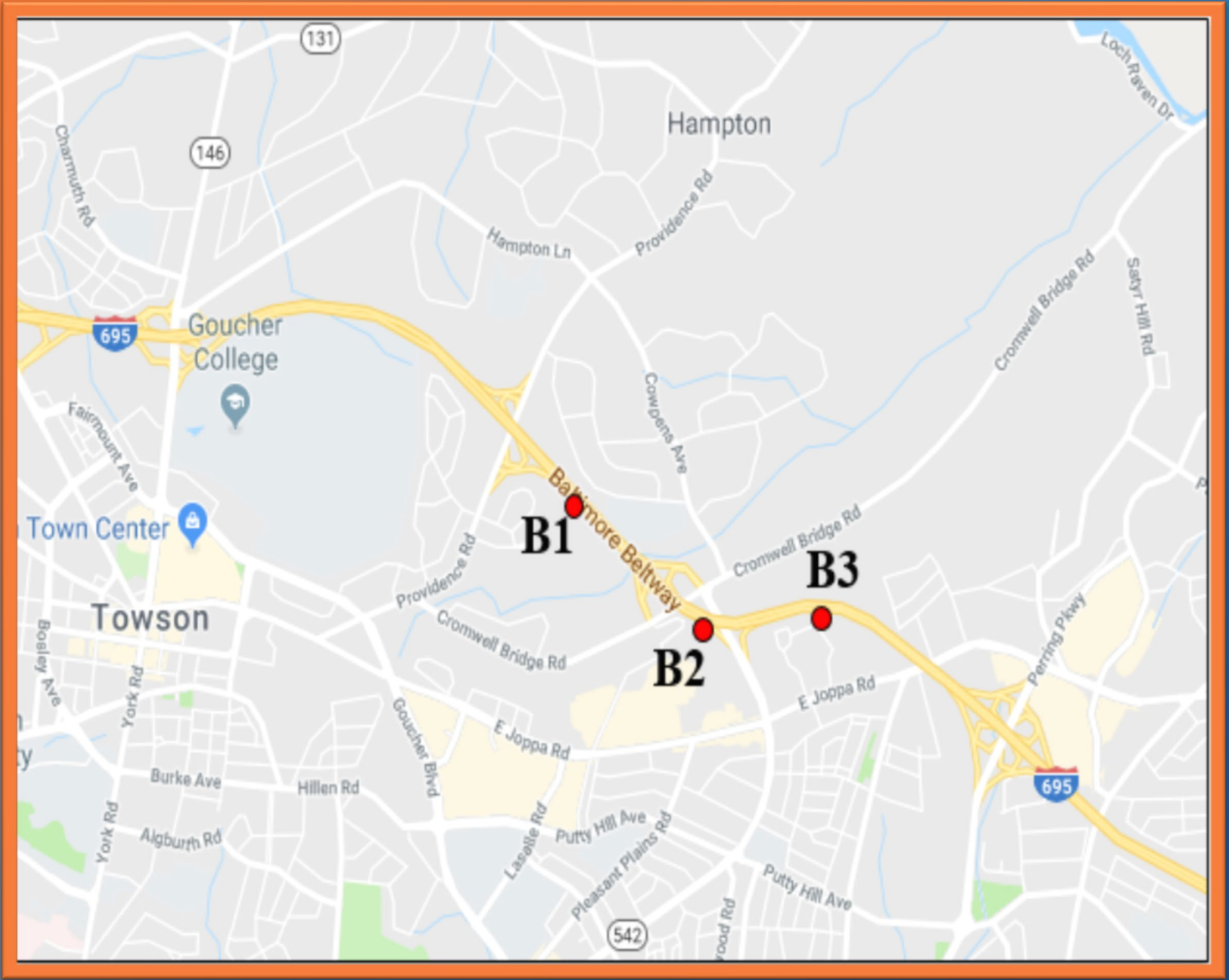
FINDINGS

- 36.5% of the participants stated that the driving simulator experience encouraged them to ***reduce cell phone use while driving***.
- After driving:
    - 51.8% expressed doubt about their ability to use cell phones freely and not make any driving mistakes
    - only 26% had stated they were doubtful in a survey given before they drove the simulator.

The Effect of Out-of-Vehicle Distraction (Billboards) on Driving Performance



- 71 Participants
- 46.5% Female
- 53.5% Male



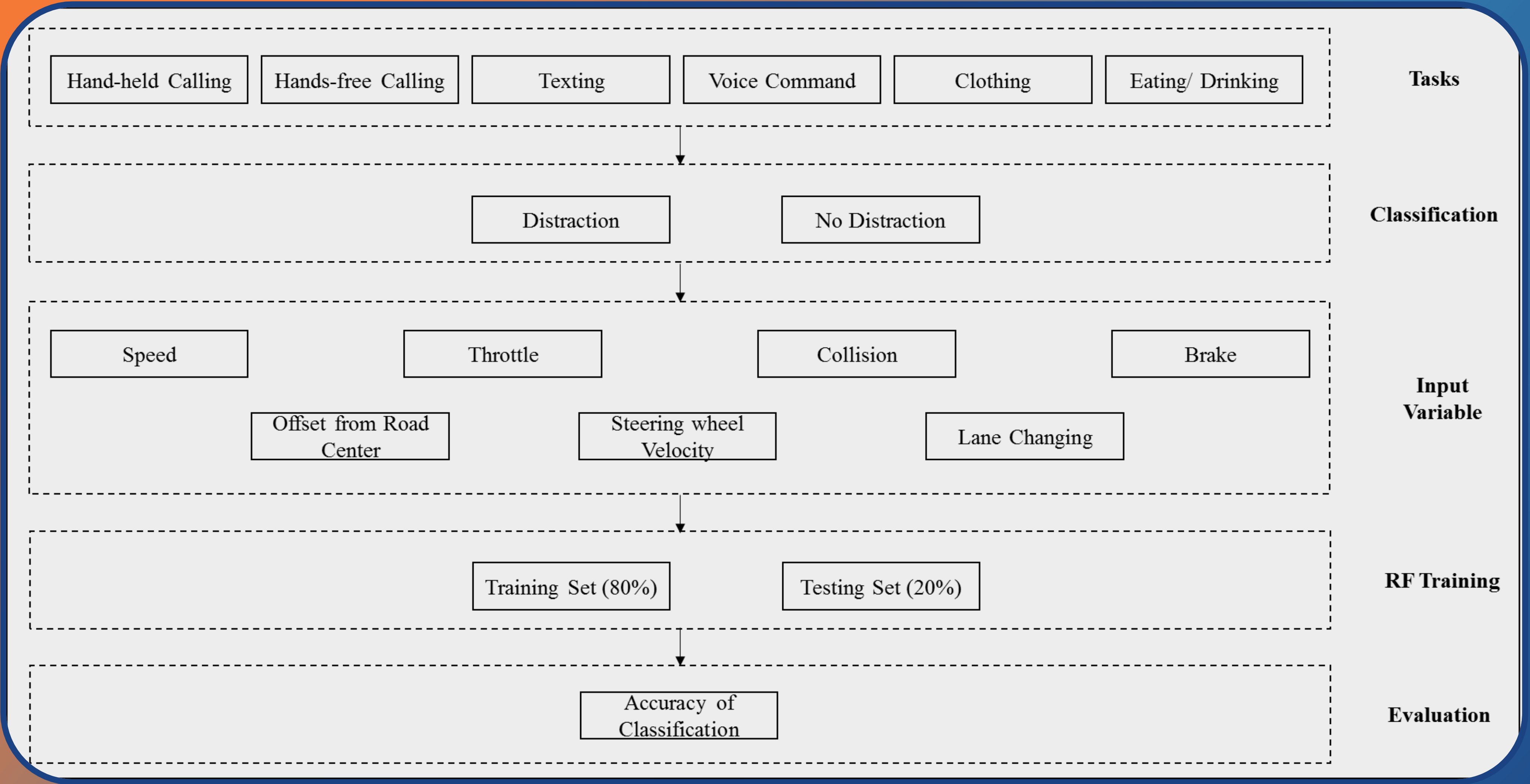
FINDINGS

- There was a slight difference in lateral performance, such as speed, throttle, brake, steering velocity, and lane changing while passing the billboards.
- Content and visibility of the billboard significantly affected gaze fixation duration.
- Female participants had lower gaze fixation duration than their male counterparts.

DEVELOPING A DISTRACTED DRIVING RECOGNITION MODEL

- Several studies have used machine-learning techniques to recognize visual and cognitive distractions for in-vehicle distraction mitigation systems.
- One of the most popular machine learning approaches is Random Forest. Because
  - Its simplicity
  - Its diversity
  - It can be used for both classification and regression tasks.

Random Forest Training Process



Tasks

Hand-held Calling
Hands-free Calling
Texting
Voice Command
Clothing
Eating/ Drinking

Classification

Distraction
No Distraction

Input Variable

Speed
Throttle
Collision
Brake
Offset from Road Center
Steering wheel Velocity
Lane Changing

RF Training

Training Set (80%)
Testing Set (20%)

Evaluation

Accuracy of Classification

Findings

Results for 10-fold cross-validation					
	Sensitivity	Precision	MCC	AUC	ACC
Before Distraction	78.80%	77.00%	53.80%	80.90%	---
During Distraction	77.00%	76.80%	53.80%	81.40%	---
Total					76.89%
Results for Independent Test					
	Sensitivity	Precision	MCC	AUC	ACC
Before Distraction	76.60%	76.40%	53.00%	86.10%	---
During Distraction	76.40%	76.60%	53.00%	86.10%	---
Total					76.50%

Findings

- The results show that the Random Forest classifier can detect driver distraction substantially with 76.5% prediction accuracy which is 8.2% better than those results reported in previous studies.
- This model can be commercialized as an after-market warning system to be utilized by drivers as a distraction warning system to reduce distraction and crash rates.
- It can also be utilized by the police department and/or insurance companies to find the driver at fault when crashes occur.

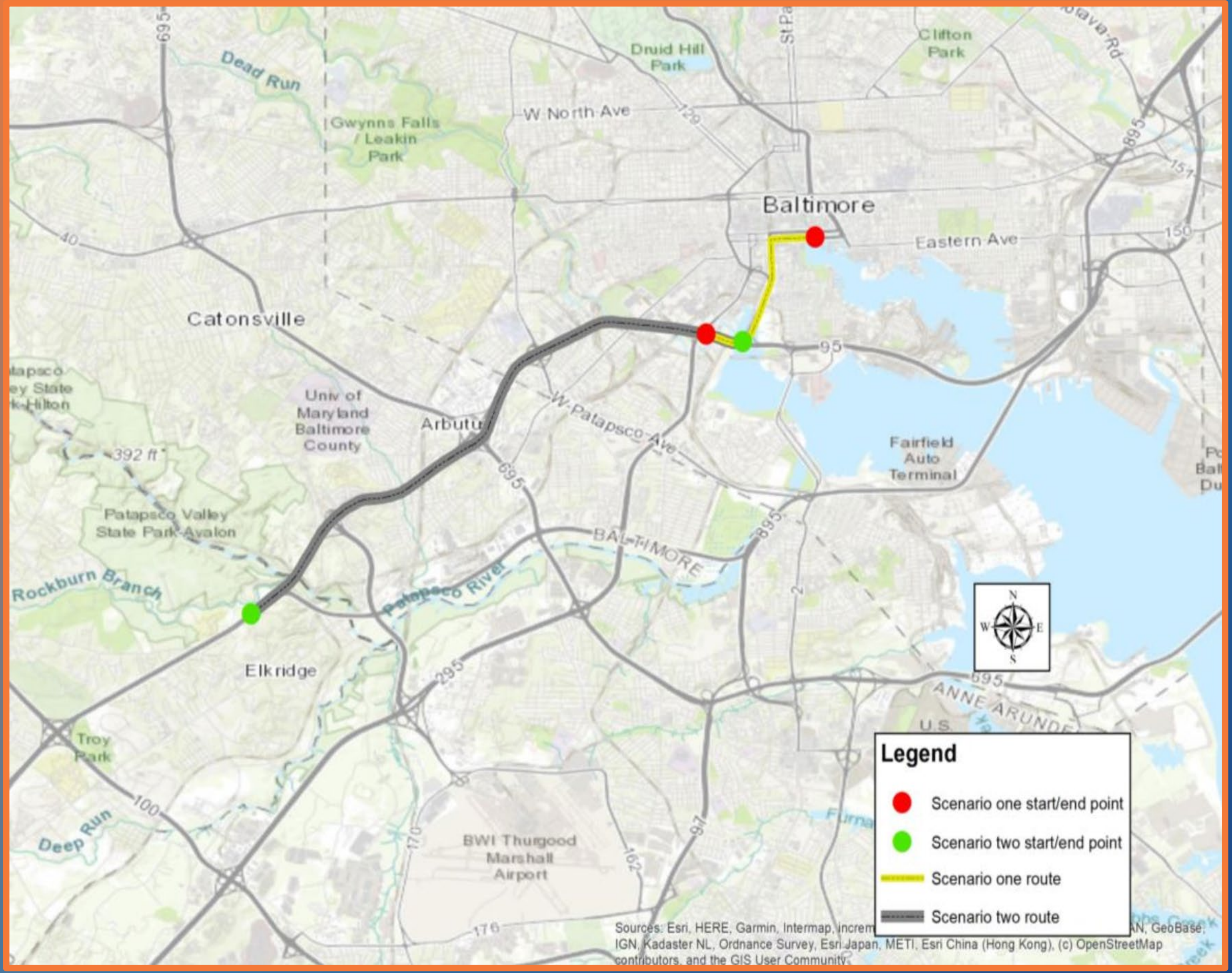
DISTRACTED DRIVING PREVENTION USING CAV

- Find if the driver is distracted using the developed distracted driver recognition model based on the driver behavior (speed, lane changing, distance from lane center, …)
- Give warning to the driver
- Or take over the driving task
- After-market package

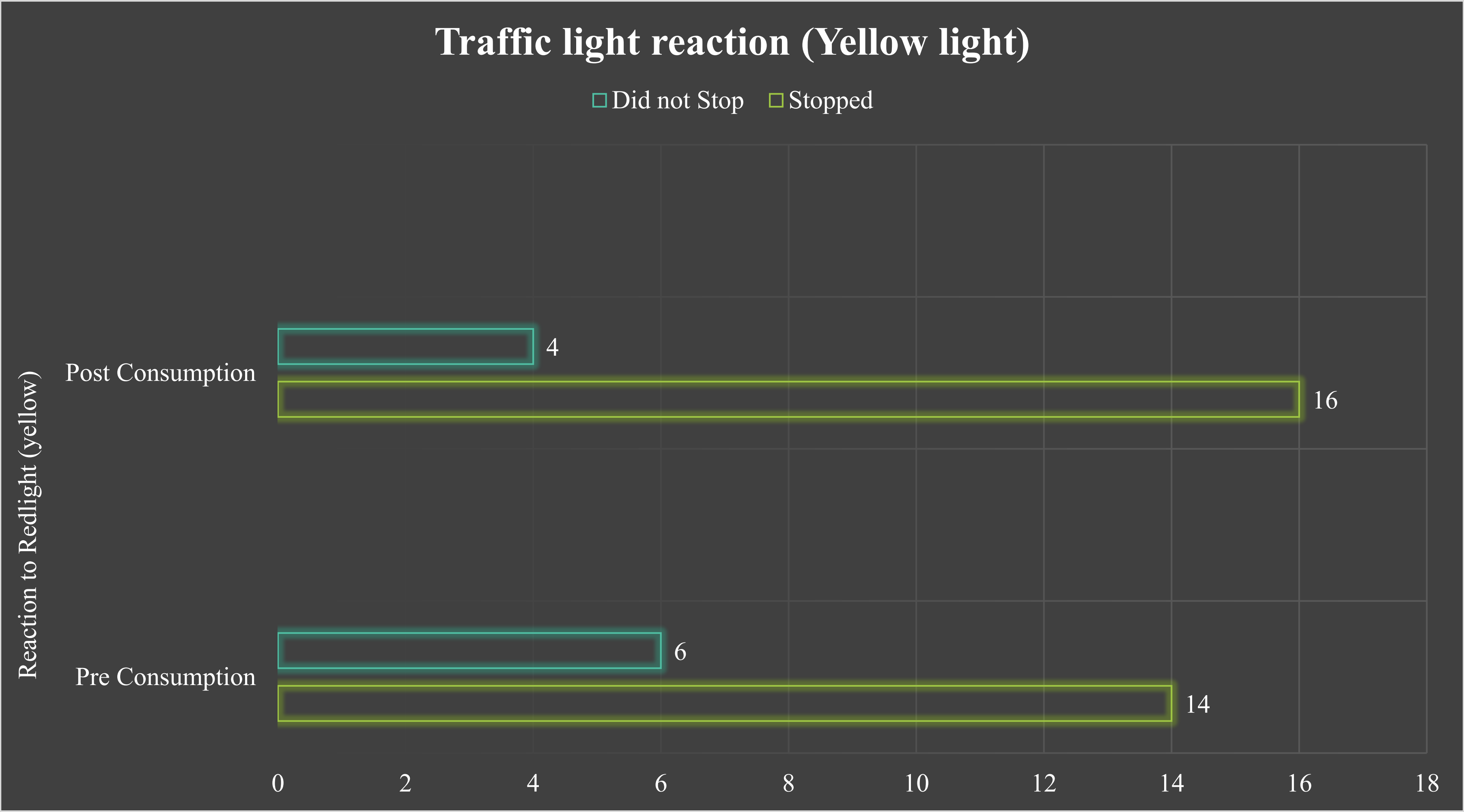
Impaired Driving

Montgomery County Police Department is the first police agency in the United States to host a cannabis intoxication impaired driving lab.
This lab's primary purpose is to train police officers to better recognize cannabis impairment as it relates to driving.

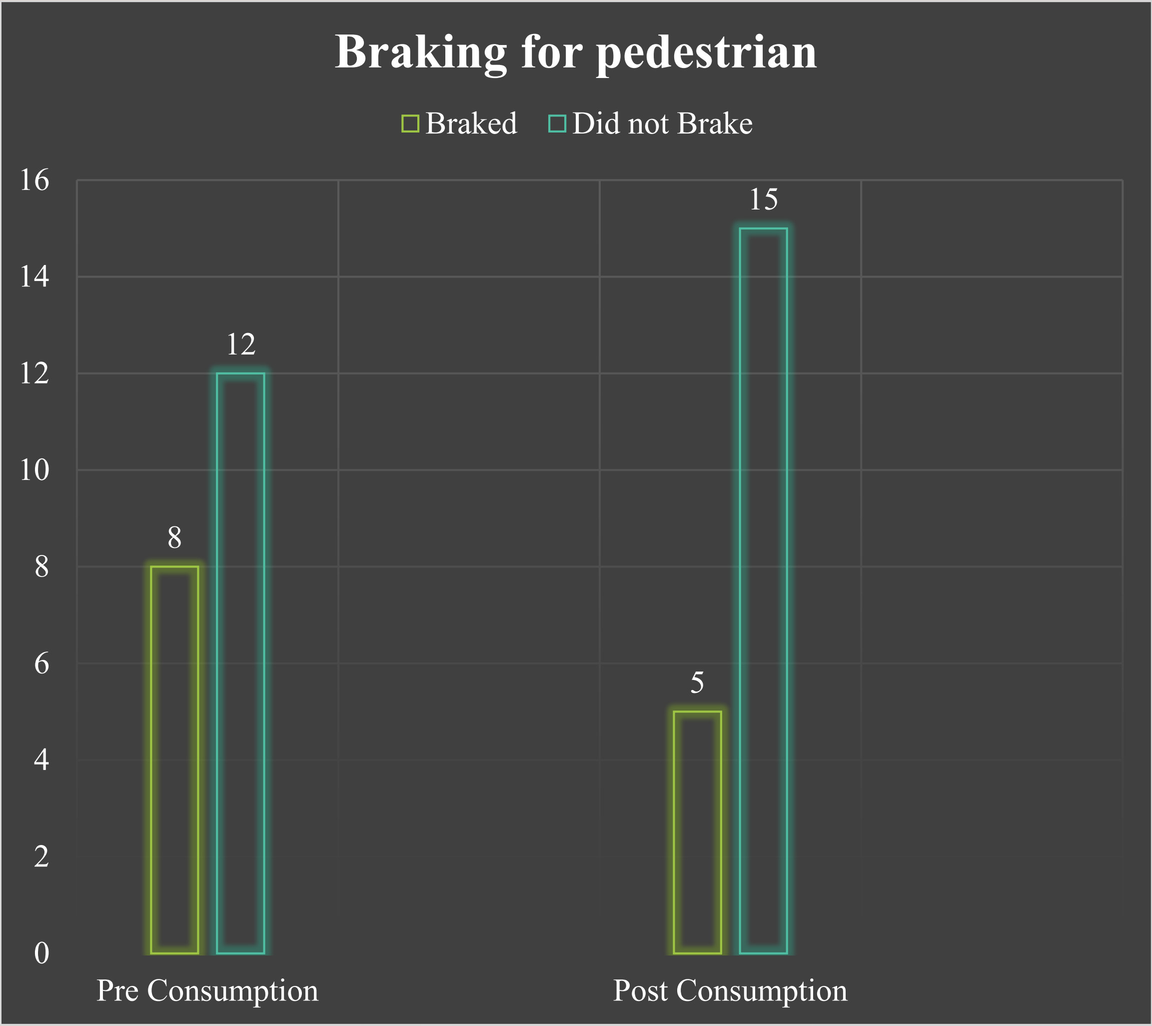
- 20 Participants
- Before and after THC consumption
- Collaboration with the Montgomery County Police Department

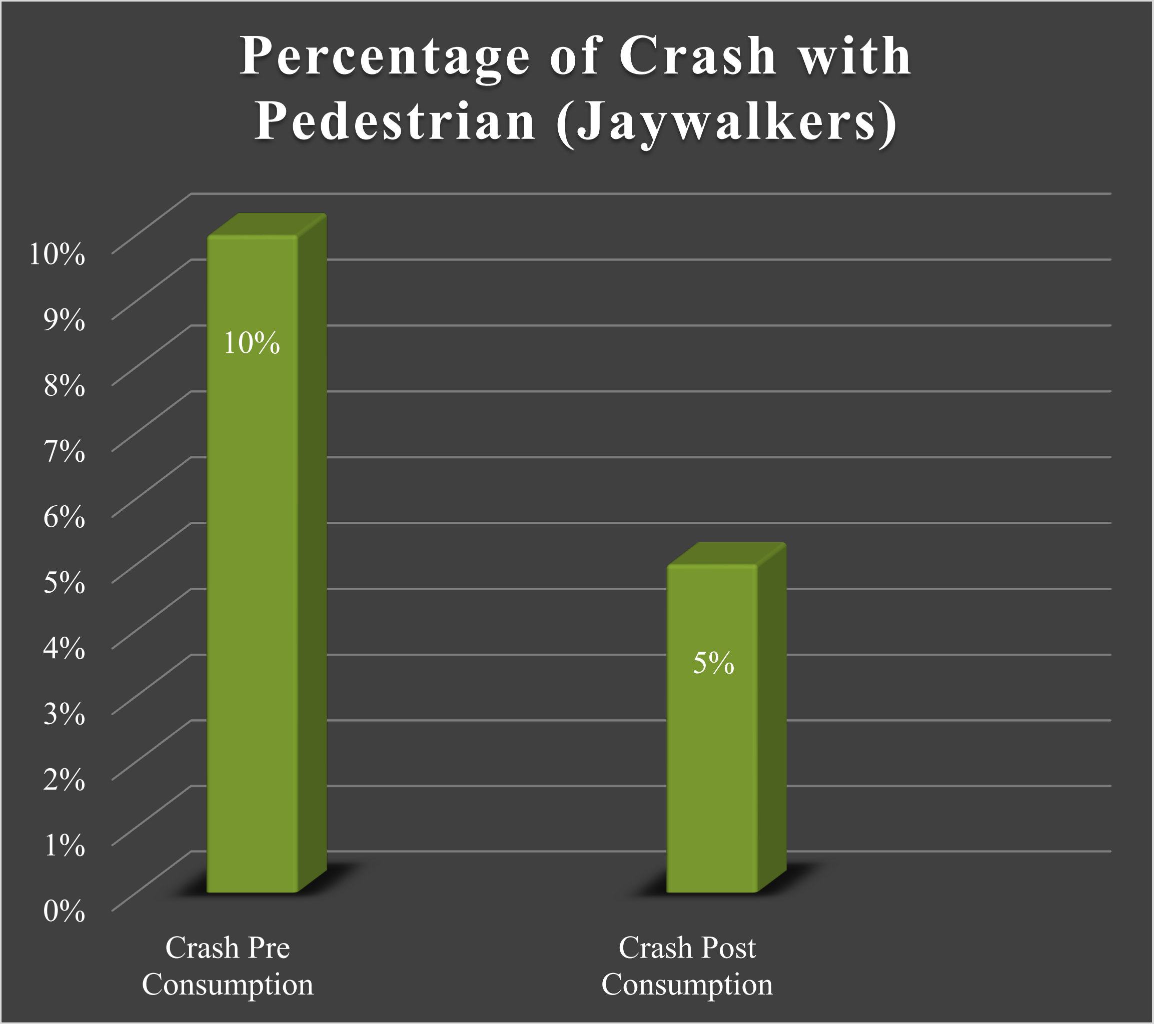


Change in Traffic Signal Light



Mid-block Running Pedestrian Encounter





Findings

- The average reaction time to switch lanes
    - pre-consumption scenario: 3.26 sec.
    - post-consumption scenario: 2.75 sec.

- After cannabis consumption
    - Participants had faster reaction time
    - More participants stopped at yellow light
    - Less participants crashed to the jaywalker

- Reasons
    - Less stress?
    - Learning effect?
    - More data is needed to conclude

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A Comprehensive Analysis of Distracted Driving using a Driving Simulator

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INTRODUCTION

- Distracted drivers are involved in about 9% of all crash fatalities, accounting for 3,166 deaths including 497 unlucky pedestrians in 2017 alone.
- With the prevalence of cell phones and their various uses, these numbers may potentially arise. Therefore, more in-depth knowledge of accepted safe driving behaviors is needed.
- Driving safely consists of performing a collection of visual-motor tasks involving a vehicle and everything else in which the tasks vary as a function of time, place and speed.
- Driver distraction occurs when a driver "is delayed in recognition of information needed to safely accomplish the driving task because some event, activity, object or person within or outside the vehicle compelled or tended to include the driver's shifting attention away from the driving task," and is the major cause of driver inattention.
- In his study, simply being "lost in thought" is another category of inattention which is distinguished from extrinsic distraction.

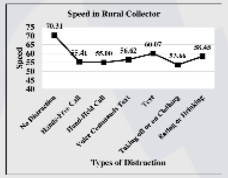
METHODOLOGY

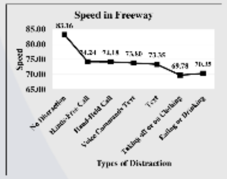
- Ninety-two young participants were recruited from Morgan State University and the Baltimore metropolitan area via flyers distributed manually, online and through social media.
- Flyer content included contact information, a summary of the requirements for the study, and an explanation of the monetary compensation for driving the simulator.
- Subsequently, prospective participants were screened for eligibility and scheduled to drive in the simulator environment.
- The participants started driving in a base scenario with no distraction to compare that driving behavior with other types of distraction.
- Participants then drove six different distraction scenarios – including hands-free call, hand-held call, voice commands text, text, taking off or on clothing, and eating or drinking – on a midsize road network north of Baltimore County that includes four different classes of the road (rural collector, freeway, urban arterial, and local road in a school zone) with different numbers of lanes and speed limits for each road.

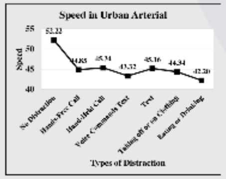
- There was one type of distraction in each scenario and the distraction happened exactly at the same location.
- The questions involved were similar in cognitive load (but different in content) for a fair comparison between different distractions.
- Participants were instructed to answer a phone call, respond to a text message upon receiving it, take off or on clothing, and drink or eat during the simulated drive.
- Participants did not know the questions they would receive as a call or text during any given scenario so that they would not exhibit anticipatory behavior that would have influenced their driving behavior.

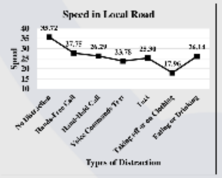
RESULT AND DISCUSSION

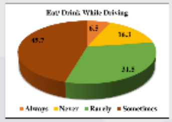
- Descriptive statistics were obtained on pre-survey questionnaire data regarding participant characteristics.
- Some 56.52% of participants were male and 43.48% were female.
- The age group of participants was between 18 to 40 years old; 44.57% of which were in the age group of 21 to 25 years.
- The pre-survey questionnaire demonstrated that 43.5% of participants use the hands-free phone, 22.8% use a hand-held phone, 21.7% text, 8.7 %read social media, 6.5% read email, 16.3%take pictures, 45.7% drink or eat, and 1.1% change their clothes when driving.
- The results of the post-survey questionnaire show a great change in the attitude of drivers after being involved in such a study.
- Some 36.5% of the participants stated that the driving simulator experience encouraged them to reduce cell phone use while driving.
- This study found taking off/on clothing eating/drinking is highly distractive. Participants deviated from lane center and reduced their speed tremendously while taking their cloth on/off and eating/drinking.

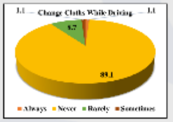






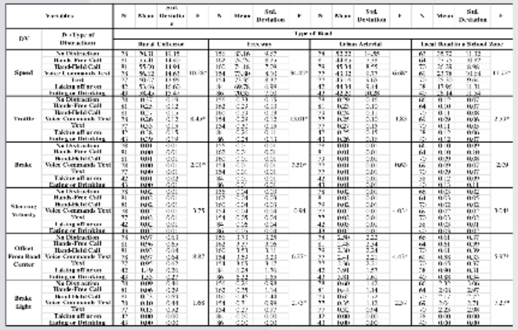






RESULT AND DISCUSSION

- Several ANOVA were conducted to compare the driving behavior under different types of distractions (no distraction, hands-free call, hands-held call, voice commands text, text, taking off or on cloth, and eating or drinking) and different road classes.
- The result of the Post hoc Tukey, reveals a significant difference of independent variables when comparing each type of distraction with no distraction.
- This result shows a negative relationship between eating or drinking and taking on/off clothing distractions and deviation from the road center, probably due to removing their hands off the wheel to do so.
- The results revealed significant differences in speed, throttle, brake, steering velocity, offset from road center, and lane change when comparing different types of distraction to no distraction.



Type of Road / Type of Distraction	Rural Collector	Freeway	Urban Arterial	Local Road in a School Zone
Hands-Free Call	-21%	-11%	-14%	-22%
Hand-Held Call	-22%	-11%	-13%	-26%
Voice Commands Text	-19%	-11%	-17%	-33%
Text	-15%	-12%	-14%	-29%
Taking off or on Clothing	-24%	-16%	-15%	-50%
Eating or Drinking	-17%	-15%	-19%	-27%

CONCLUSION

- Participants decreased their speed in the presence of all distractions on all types of roads.
  - The highest speed reduction happened on the local road when taking on/off clothing (50%), voice command texting (33%), and texting (29%).
  - In general, speed reduction was the highest on the local road.
- Participants applied the brakes more often and more forcefully when distracted.
- Steering velocity increased on the freeway for all distractions and in eating/drinking distractions on all roads.
- Offset from the center of the lane increased dramatically when taking on/off clothing and eating/drinking, especially on the freeway (about 70%).
- Some 36.5% of the participants stated that the driving simulator experience encouraged them to reduce cell phone use while driving.
- After driving, 51.8% expressed doubt about their ability to use cell phones freely and not make any driving mistakes; 26% had stated they were doubtful in a survey given before they drove the simulator.

ACKNOWLEDGMENTS

- The authors would like to thank the Maryland Department of Transportation-Motor Vehicle Administration-Maryland Highway Safety Office (GN-Morgan State -2019-291) and Urban Mobility and Equity Center, a Tier 1 University Transportation Center of the U.S. DOT University Transportation Centers Program, at Morgan State University for their funding support.

Predicting Driving Distraction Patterns in Different Road Classes Using Support Vector Machine

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INTRODUCTION

- One of the most significant traffic safety problems is driver distraction.
- According to the National Highway Traffic Safety Administration (NHTSA), 9% of all fatal crashes are attributed to driver distraction, resulting in as many as 37,133 fatalities, which involved 2,994 distracted drivers in 2017.
- The distraction problem is getting worse due to the increasing use of in-vehicle information systems such as GPS navigation systems, cell phones, and satellite radios.
- Modern vehicles are filled with driver-assistance technology such as a navigator, multimedia displays, climate control, parking radar, and many more. Although drivers benefit from such modern driving assistance technologies, it is still critical for drivers to avoid distraction and pay suitable attention to the road.
- Driver distraction happens when an object or event attracts a person's attention away from the driving task.

METHODOLOGY

- To investigate distracted drivers' performance associated with different types of distraction on four different road types (rural collector, freeway, urban arterial, and local road in a school zone), two surveys and a driving simulation experiment were conducted.
- The driving simulation experiment examined an individual's driving performance with different forms of distraction (text, voice command, hand-held call, hands-free call, eating/drinking, and changing clothes) on different road types.
- The designed experiment allowed a complete analysis of each participant's driving performance (speed, brake, throttle, and crash) given various types of roads as well as different forms of distraction.
- Two surveys were designed for this study.
- The pre-survey, which participants filled out before their driving experience, included sociodemographic information as well as questions about distracted driving habits (if they use a cellphone when driving, have a crash when using GPS).
- The post-survey that participants filled out after their driving simulator experience included the probability of using a cellphone or other distracting tasks when driving after being involved in this study.
- A total of 92 participants, 40 females and 52 males participated in the survey.
- The participants drove from Hampton Lane (rural road) to I-695 (freeway) to Perring Parkway (urban arterial) to Radar Road (local, school zone), which takes about 15 minutes.

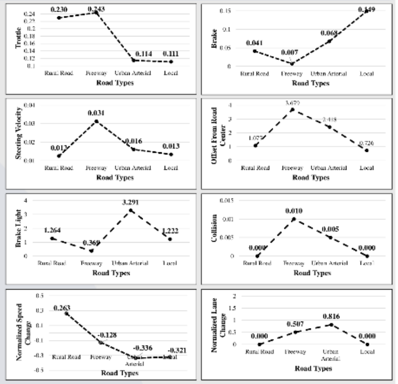
Variable		**Frequency**	**Percent**
Gender	Female	40	43.5
	Male	52	56.5
Age	18 to 20	15	16.3
	21 to 25	41	44.6
	26 to 30	15	16.3
	31 to 35	9	9.8
	36 to 40	12	13.0
Education Status	Associate degree	7	7.6
	College graduate	14	15.2
	College student	50	54.3
	High School or less	15	16.3
	Postgraduate	6	6.5
Employment Status	No	44	47.8
	Full-time	18	19.6
	Part-time	30	32.6
Household Annual Income	$20K to $30K	18	19.6
	$30K to $50K	19	20.7
	$50K to $75K	11	12.0
	$75K to $100K	2	2.2
	Less than $20K	27	29.3
	More than $100K	15	16.3
Household Size	1	23	25.0
	2	23	25.0
	3	18	19.6
	4 or more	28	30.4

RESULT AND DISCUSSION

- We used an ANOVA and post hoc Tukey to find differences in distracted driving behavior on different road types.
- Speed, throttle (ratio on the acceleration pedal from 0 to +1 in which 0 means no throttle and +1 is full throttle), brake (ratio on the brake pedal from 0 to +1 in which 0 means no braking force and +1 is maximum brake force), steering velocity (rotation rate of the steering wheel per second), offset from road center (offset of the vehicle's position from the center of the road in meters; a negative number shows the offset toward left and a positive number shows the offset toward right), lane change, collision, and brake light (frequency of brake lights turning on) are dependent variables, and road type (rural, freeway, urban, and local) is the independent variable.
- All variables are only for the distraction period.
- Since different road types have different speed limits and numbers of lanes, to have a fair comparison of driving behavior under distraction on different roads, we first normalized data and then performed an ANOVA analysis.
- The speed limit on the rural road is 30 mph, the freeway is 55, the urban arterial is 45 and the local road is 30; also, the number of lanes in each direction on the rural road is one, the freeway has three, the urban arterial has two, and the local road has one.
- To normalize speed, we subtract the vehicle speed from the speed limit and divide it by the speed limit.
- The result of the ANOVA shows that distracted driving behavior is significantly different under different road types for all variables except collision.

Variables		**N**	**Mean**	**Std. Deviation**	**F**	**Sig.**
Normalized Speed	**Rural Road**	402	0.263	0.314	865.849	0.000
	Freeway	800	-0.128	0.088		
	Urban Arterial	399	-0.336	0.126		
	Local	351	-0.321	0.219		
Throttle	**Rural Road**	402	0.230	0.111	287.391	0.000
	Freeway	800	0.243	0.094		
	Urban Arterial	399	0.114	0.062		
	Local	351	0.111	0.094		
Brake	**Rural Road**	402	0.041	0.048	370.743	0.000
	Freeway	800	0.007	0.007		
	Urban Arterial	399	0.068	0.055		
	Local	351	0.149	0.138		
Steering Velocity	**Rural Road**	402	0.012	0.009	187.104	0.000
	Freeway	800	0.031	0.021		
	Urban Arterial	399	0.016	0.010		
	Local	351	0.013	0.015		
Offset from Road Center	**Rural Road**	402	1.077	0.640	223.594	0.000
	Freeway	800	3.679	2.887		
	Urban Arterial	399	2.418	2.124		
	Local	351	0.726	0.441		
Normalized Lane Change	**Rural Road**	402	0.000	0.000	380.228	0.000
	Freeway	800	0.507	0.549		
	Urban Arterial	399	0.816	0.492		
	Local	351	0.000	0.000		
Collision	**Rural Road**	402	0.000	0.000	1.811	0.143
	Freeway	800	0.010	0.111		
	Urban Arterial	399	0.005	0.100		
	Local	351	0.000	0.000		
Brake Light	**Rural Road**	402	1.264	2.414	87.713	0.000
	Freeway	800	0.369	1.150		
	Urban Arterial	399	3.291	5.395		
	Local	351	1.222	2.319		

RESULT AND DISCUSSION



- Tukey Post Hoc analysis reveals that there is a statistically significant difference in the mean of speed, throttle, brake, steering velocity, offset from road center, lane change, and brake light among different road types.
- To evaluate our model, we randomly split our data for each subject set (1,952 experiments) into training (80% of the samples) and independent test sets (20% of the samples).
- As a result, we have 1,587 samples in our training data set and 365 samples in our testing data set.
- we classify four different distraction definitions based on the road types (rural collector, freeway, urban arterial, and local road in a school zone) using SVMs.
- SVM is able to predict the distraction with respect to the road with 94.24% accuracy for the independent test set and 93.90% for 10-fold cross-validation.
- The similar results achieved for these two evaluation methods demonstrate the generality of our achieved results.

Results of 10-fold cross-validation

	Sensitivity	**Precision**	**MCC**	**AUC**	**ACC**
Rural Collector	92.30%	92.30%	90.30%	97.20%	---
Freeway	97.80%	93.30%	92.30%	96.60%	---
Urban arterial	94.00%	98.20%	95.10%	98.40%	---
Local road in a School Zone	86.90%	92.40%	87.40%	96.50%	---
Total					93.90%

Results of Independent Test

	Sensitivity	**Precision**	**MCC**	**AUC**	**ACC**
Rural Collector	93.40%	98.60%	95.00%	98.40%	---
Freeway	99.30%	89.80%	90.30%	95.90%	---
Urban arterial	92.00%	98.60%	94.10%	98.30%	---
Local road in a School Zone	85.90%	96.50%	89.30%	94.40%	---
Total					94.24%

CONCLUSION

- The ANOVA and Tukey Post HOC results indicated that participants tend to demonstrate different driving behavior under distraction on different road types.
- However, the number of crashes are not significantly different on different roads.
- The Support Vector Machine (SVM) method recognized and predicted the pattern with 94.24% accuracy for the independent test set and 93.9% for 10-fold cross-validation.
- The results showed that the participants drove over the speed limit when distracted on rural roads. This is most probably due to very low traffic flow and low cognitive load, which could increase the probability of crashes in the case of an interruption such as an animal passing.
- Conversely, driving on freeways at 13% under the speed limit (to focus on the distracting event such as texting) could cause crashes with cars moving at speeds higher than the speed limit, especially in the left lanes.
- Driving on the freeway had the least force of brake pedal while driving on the local road had the most, and that can be related to a load of scenery and intersections.
- On all four different roads, there was an offset from the road center toward the right; the freeway had the most offset and the local road had the least.

ACKNOWLEDGMENTS

- The authors would like to thank the Maryland Department of Transportation-Motor Vehicle Administration-Maryland Highway Safety Office (GN-Morgan State-2019-291) and Urban Mobility and Equity Center at Morgan State University for their funding support.

Safety And Behavioral Analysis Center

SABA

MORGAN STATE UNIVERSITY

A Machine Learning Distracted Driving Prediction Model

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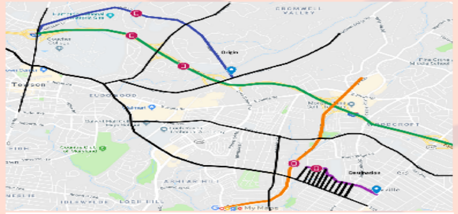
INTRODUCTION

- Distracted driving is defined as diverting the attention of the driver from driving to other behaviors.
- Distracted driving may have different causes such as eating, drinking, manipulating dashboard controls, visual deviations like looking at a smartphone screen, or cognitive activities like talking on the phone that take the attention of the driver away from driving.
- In this study we propose a new machine learning model to predict if the driver is distracted. To do this, we use a Bayesian Network (BN) to build our model and a Genetic Algorithm (GA) to optimize its network.

METHODOLOGY

- Driving data such as speed, acceleration, throttle, lane changing, brake, collision, and offset from the lane center were collected in a fixed high-fidelity driving simulator.
- A medium road network of Baltimore County which consists of various road types (rural collector, freeway, urban arterial, and local road in a school zone) was considered as the study area.

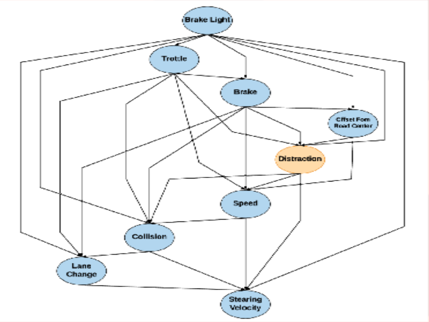


Study Area
(Blue line is a rural collector, green line is a freeway, orange line is an urban arterial and purple line is a local road; the red icons show the location of the distraction)

- Using online advertisements, flyers, and email invitations, 92 participants were recruited from Morgan State University and the Baltimore metro area to drive eight different scenarios.
- Some 56.52% of participants were male and 43.48% were female.
- The age group of participants was between 18 to 40 years old; 44.57% of which were in the age group of 21 to 25 years.
- Participants were required to have a valid U.S. driver's license and were compensated at $15 per hour for their participation in the study.

RESULT AND DISCUSSION

- A BN is originated based on the fundamental relationship among variables in a visual representation.
- In the BN graph nodes represent the variables and links represent the relationship among them.
- Building the Bayesian Network and finding the best arrangements among the nodes can be defined as an optimization task.



- After the recognition of a good network structure, the conditional probability tables for each of the variables are estimated.
- A natural way to measure how well a Bayesian network performs on a given data set is to forecast its future performance by guessing expected functions, such as classification accuracy.
- To be able to properly conduct our experimentation, avoiding bias and investigating the generality of our model, we divide our data into training and independent testing sets.
- We separate 80% of our samples as training (1,563) and 20% as testing (389).
- We report 10-fold cross validation on the training set and the independent test set results to study the generality of our model.
- Using k = 10 has been shown as an efficient number and widely used in the literature. In this way, we utilize our data to use it more efficiently and repeat our experimentation to investigate its generality.

RESULT AND DISCUSSION continued

- We use 10-fold cross validation just for our training set.
- We also train our model in a different task on the training set and use that for our independent test set.
- To provide more insight on the performance of our model, we report the prediction accuracy (ACC), sensitivity (true positive rate), precision, Matthews Correlation Coefficient (MCC), and Area Under the ROC curve (AUC).
- we achieve 67.8% prediction accuracy for our independent test set. We also achieve 62.6% Sensitivity and 75.1% AUC which highlights the ability of our proposed model to identify distractions, correctly.
- We also achieve 70.8% accuracy which is consistent with our results on the independent test set which demonstrates the generality of our model.

Results for 10-fold cross validation

	Sensitivity	Precision	MCC	AUC	ACC
Before Distraction	61.6%	75.5%	42.3%	77.7%	70.8%
During Distraction	80.0%	67.6%	42.3%	77.7%	70.8%

Results on Independent Test

	Sensitivity	Precision	MCC	AUC	ACC
Before Distraction	73.0%	66.0%	35.8%	75.1%	67.8%
During Distraction	62.6%	69.9%	35.8%	75.1%	67.8%

CONCLUSION

- This paper developed a methodology using a BN, a powerful machine learning method, to detect driver distraction from driving performance using a driving simulator.
- The connections between driving performance and driver distraction are explored in this paper, the results of which can be used to detect distracted driving and find the best strategies to overcome this problem.
- The results show that the BN model is able to detect driver distraction substantially with 67.8% prediction accuracy.
- This also demonstrate the promising performance of a machine learning model for the driver distraction prediction problem.
- More effective policies and technologies could be implemented when driver distraction can be predicted.

ACKNOWLEDGEMENTS

- This work was supported by the Maryland Department of Transportation-Motor Vehicle Administration-Maryland Highway Safety Office (GN-Morgan State -2019-291) and Urban Mobility and Equity Center at Morgan State University for their funding support.

Report

- https://www.morgan.edu/Documents/ACADEMICS/CENTERS/NTC/DD_Report_V21.pdf

Thank You

Questions?