REGIONAL SAFETY TASK FORCE

Behavioral Safety in the Safe System: Distracted Driving

September 16, 2022

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

CONNECT WITH US! @DVRPC #RSTF #VISIONZERO

Housekeeping

- Number of attendees
- Meeting recorded and posted on webpage
- Use Chat feature for questions and to relay technical issues
- Closed captioning available
- Mic and video features enabled for breakout groups

Share the conversation!
Use **#rstf** during today's meeting, and
tag **@DVRPC**

Opening Remarks

- **Sharang Malaviya, P.E.,** Traffic Safety Supervisor, PA Department of Transportation

Agenda

- Introduction
- Emphasis Area content
  - Introduction
  - Guest Speakers
- Breakout Groups
- DVRPC SS4A Application Update
- Conclusion

REGIONAL SAFETY TASK FORCE

dvrpc

- **RSTF Goal:** To reduce roadway crashes and eliminate serious injuries and fatalities from crashes in the Delaware Valley

Share the conversation!
Use **#rstf** during today's meeting, and tag **@DVRPC**

RSTF Action Items

- What is an action item?
  -  A discrete task that an RSTF member can volunteer for
  -  Can be as simple as making a connection between two organizations or researching an issue
  -  Something new (not something that is already part of your current workload), but manageable
  -  Will help move the needle on traffic safety in the region.
- Action Items are available to view on the RSTF webpage
- If you would like to volunteer for an unclaimed action item, reach out to Marco at mgorini@dvrpc.org

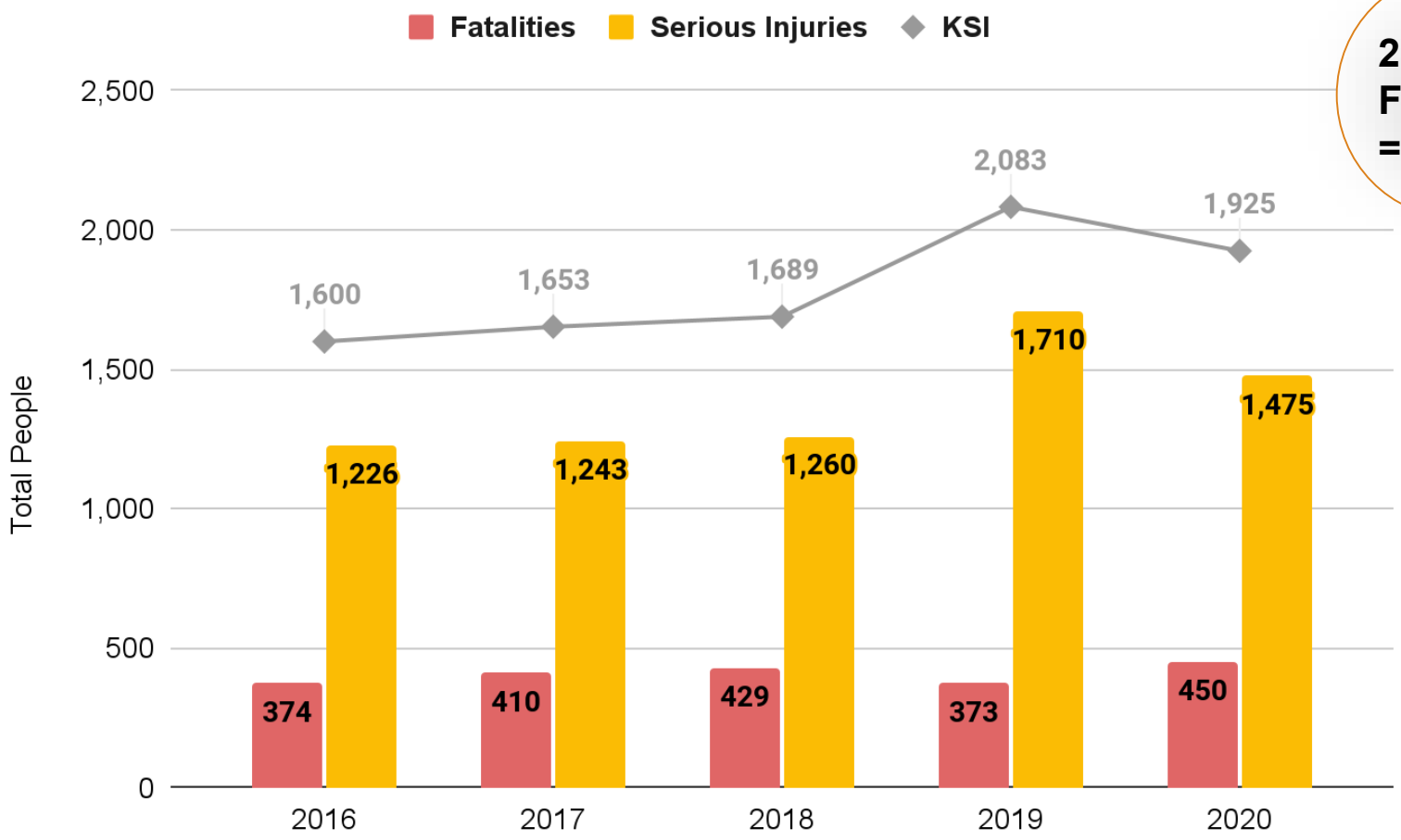
Action Item Spotlight

- Tom Edinger, DVRPC
  - Topic: Safe Speeds
  - Action: Investigate **post-COVID changes to traffic patterns** and how this impacts travel speed
  - Update:
    - Looked at AM/PM peak, limited and non-limited access CMP corridors
    - Trend for each of the analysis scenarios is lower speeds pre-COVID, highest speeds in April-June 2020, and speeds getting closer to pre-COVID levels comparing the same months pre- and post-COVID.

Introduction

- **Kevin Murphy,** Manager, Office of Safe Streets, Delaware Valley Regional Planning Commission

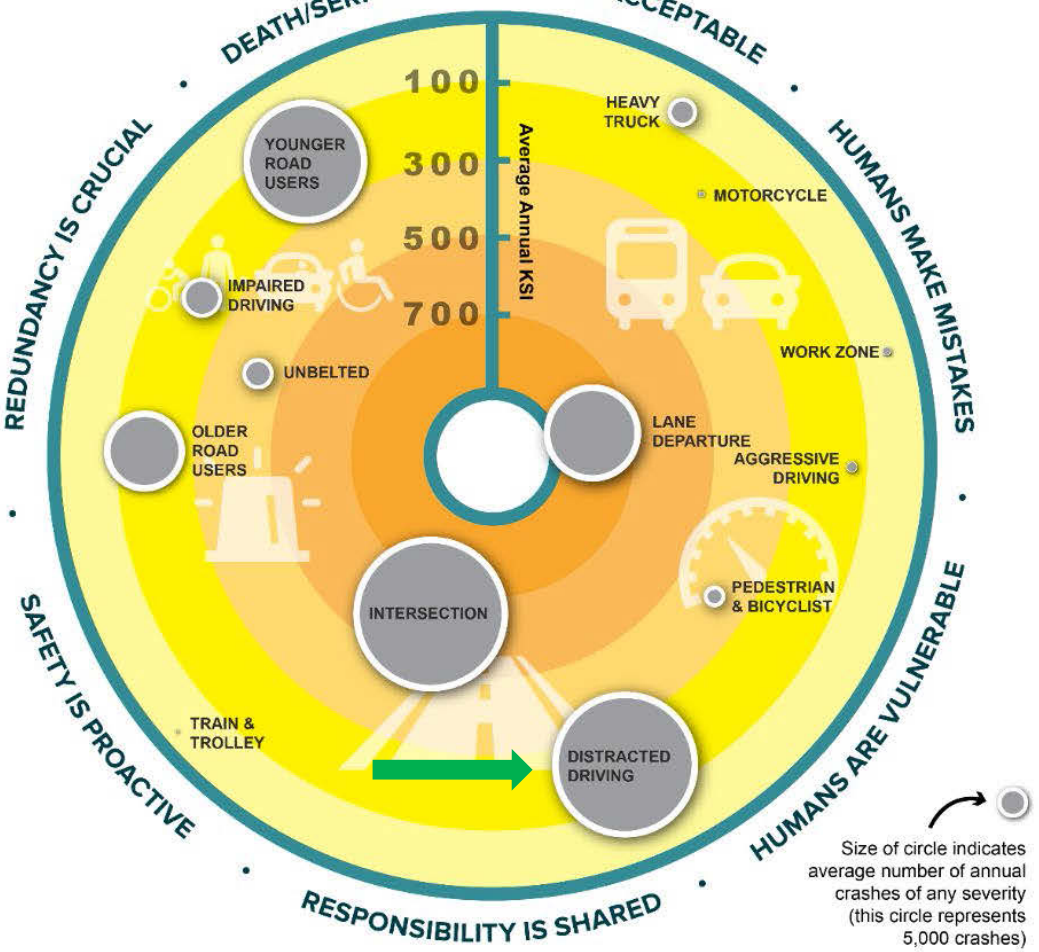
Total KSI - Regional Trend (by person), 2016-2020



2021 Fatalities = 483

KSI & Total Crashes by Emphasis Area

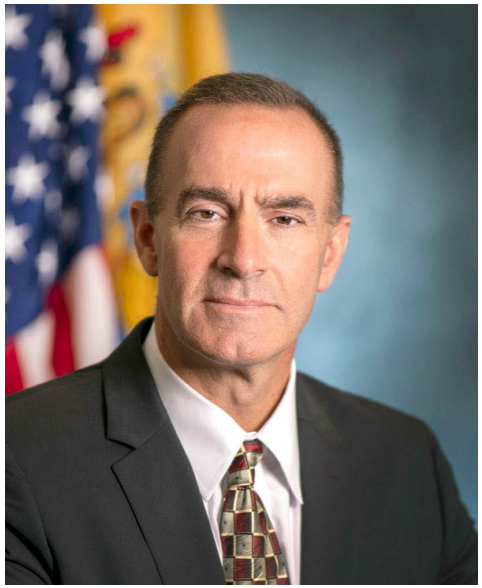
2021 Transportation Safety Analysis & Plan




Transportation Safety Analysis and Plan
The Road Safety Plan for the Greater Philadelphia Region
6th Edition
April 20, 2022
DELAWARE VALLEY
dvrpc
REGIONAL PLANNING COMMISSION
REGIONAL
SAFETY
TASK FORCE

Guest Speakers

- **Eric Heitmann,** NJ Division of Highway Traffic Safety
- **Dr. Mohammad Jalayer,** Rowan University



Action Item Development Groups

- Continuing the conversation in small breakout groups
- Brainstorm strategies to advance Safe System approach strategies

Action Items Report-back

- One-minute reports on break out group discussions

Safe Streets and Roads For All Update

Closing Remarks

- **Sean Meehan,** Senior Research Specialist, Alan M. Voorhees Transportation Center

Please Complete the Meeting Survey!

- The link for the survey is in the Chat, please take a moment to get it started now

Announcements

- Sept 17: Open Streets in Trenton – learn about Vision Zero with DVRPC!
- Sept 19-23: 5th National Roundabouts Week
- Oct 11: NJ Safety Summit

Do you have any announcements? Share in the chat!

Next Meeting

- Next RSTF meeting is planned for December 2022
- Adjourn

Thank You!

REGIONAL SAFETY TASK FORCE

Marco Gorini, Transportation Planner
617-869-0225 | mgorini@dvrpc.org

Kevin Murphy, Manager, Office of Safe Streets
215-238-2868 | kmurphy@dvrpc.org

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

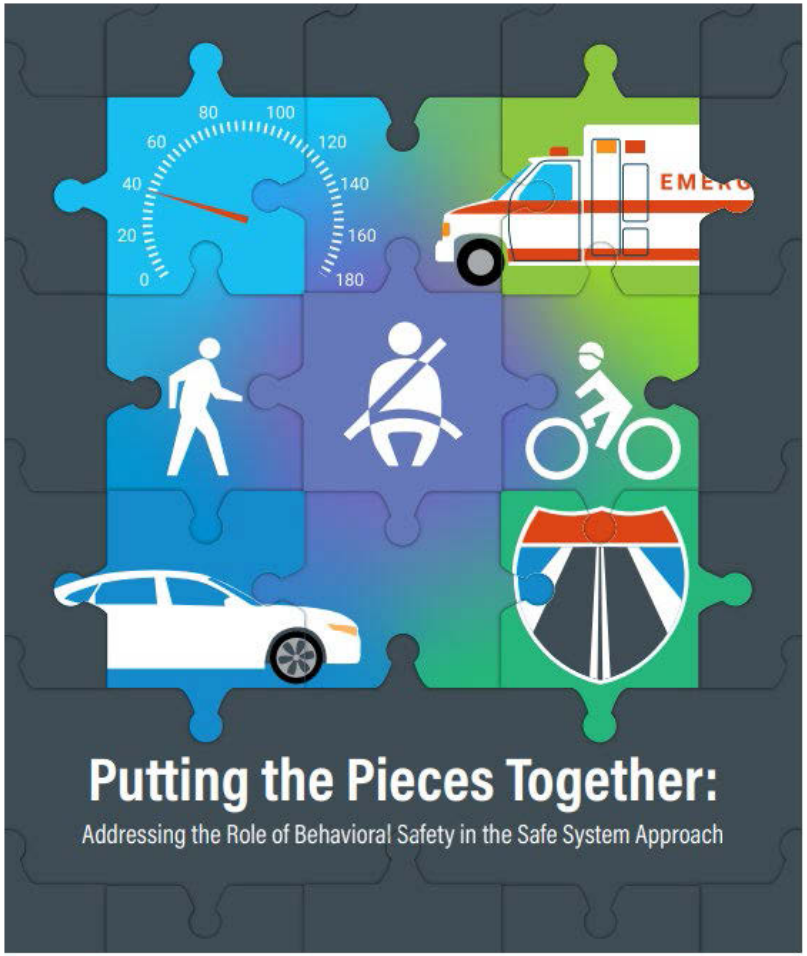
CONNECT WITH US! @DVRPC #RSTF #VISIONZERO

The Role of Behavioral Safety in the Safe System Approach

Eric Heitmann
Director
NJ Division of Highway Traffic Safety

GHSA
Governors Highway Safety Association®
The States' Voice on Highway Safety

GHSA / Cambridge report



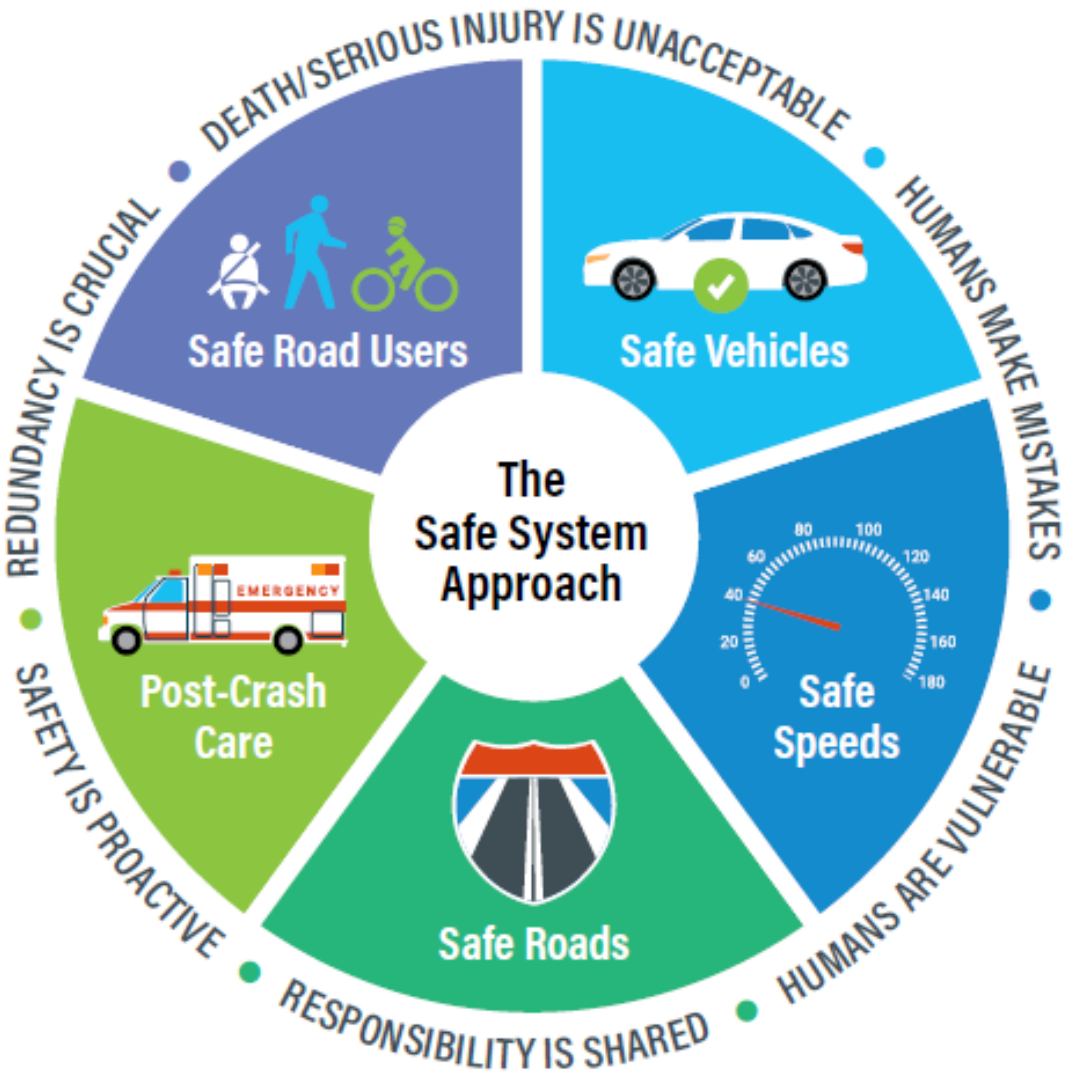
A report by Cambridge Systematics, Inc. for the Governors Highway Safety Association

CAMBRIDGE SYSTEMATICS

GHSA Governors Highway Safety Association The States' Voice on Highway Safety

GHSA Governors Highway Safety Association The States' Voice on Highway Safety

The Safe System Approach



Misconceptions

- *Behavioral safety has little to no role in promoting safety culture*
- The Four E's approach is outdated, different from the Safe System approach
- Safe System is an engineering approach
- Behavioral safety cannot be implemented equitably
- *Behavioral safety does not evolve*

Behavioral Safe System Framework

SHSO Operations					
Death/Serious Injury is Unacceptable	**Humans Make Mistakes**	**Humans Are Vulnerable**	**Responsibility is Shared**	**Safety is Proactive**	**Redundancy is Crucial**
Leadership					
• Lead efforts to change (or keep) the state's goal of zero fatalities and serious injuries.	• Work with engineers to identify and remediate areas with behavioral driving issues.		• Establish and nurture a safety culture in the SHSO, its broader agency, within the safety community and statewide with the public.	• Reinforce that everyone has a role to play in ensuring safety programs and traffic enforcement are equitable.	• Seek consistent Safe System messaging from the Governor's office and all state agencies.
Communication					
• Explain to road users how to safely use the system.	• Educate the public on how they can avoid being involved in a crash (e.g., obey the speed limit because roads are designed to only handle certain speed thresholds).	• Educate drivers about what they can do to better tolerate crash impacts and avoid or minimize injury.	• Explain to road users their responsibilities when using the system for each mode of travel. • Leverage SHSO education and marketing expertise to help inform the public of technology and infrastructure solutions.	• Ensure everything the SHSO does aligns with the Safety System approach.	• Lead production of branded Safe System marketing and outreach materials.

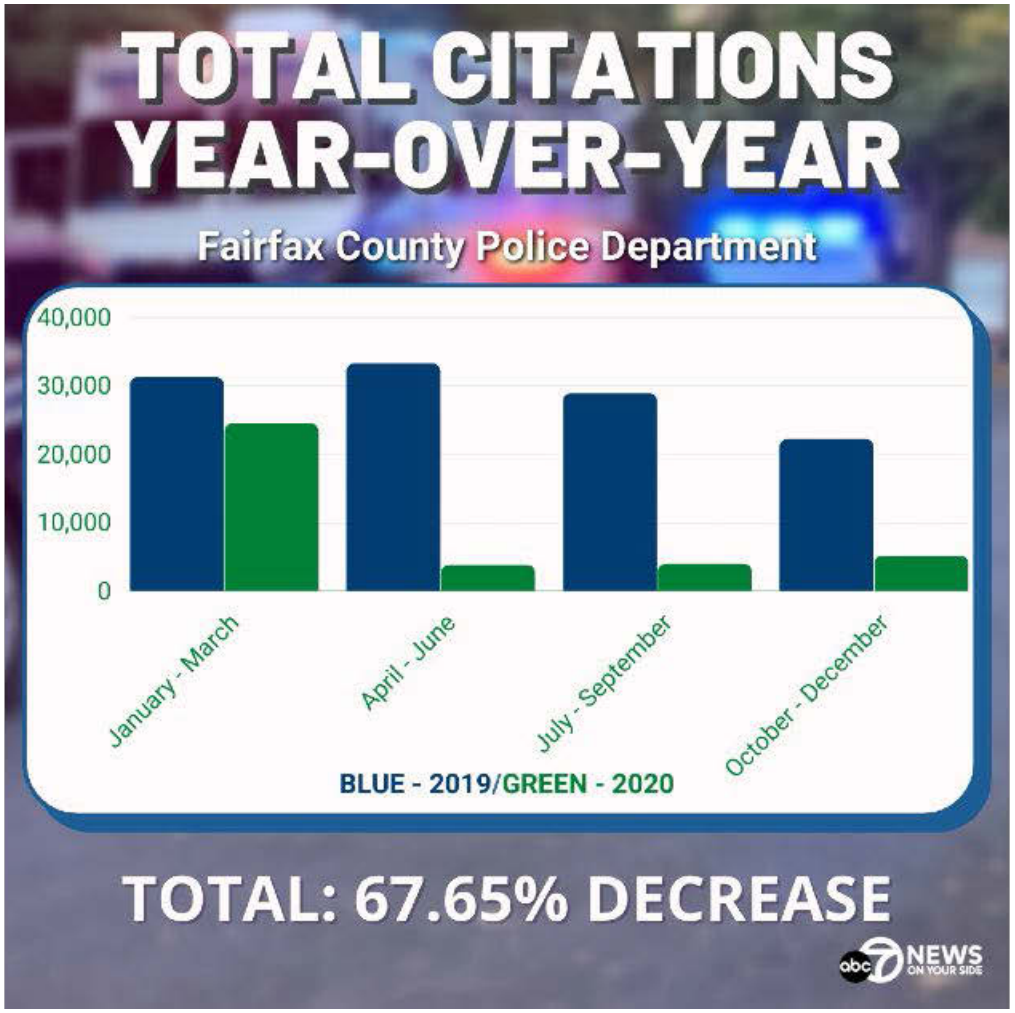
Behavioral Safe System Framework

SHSO Programs

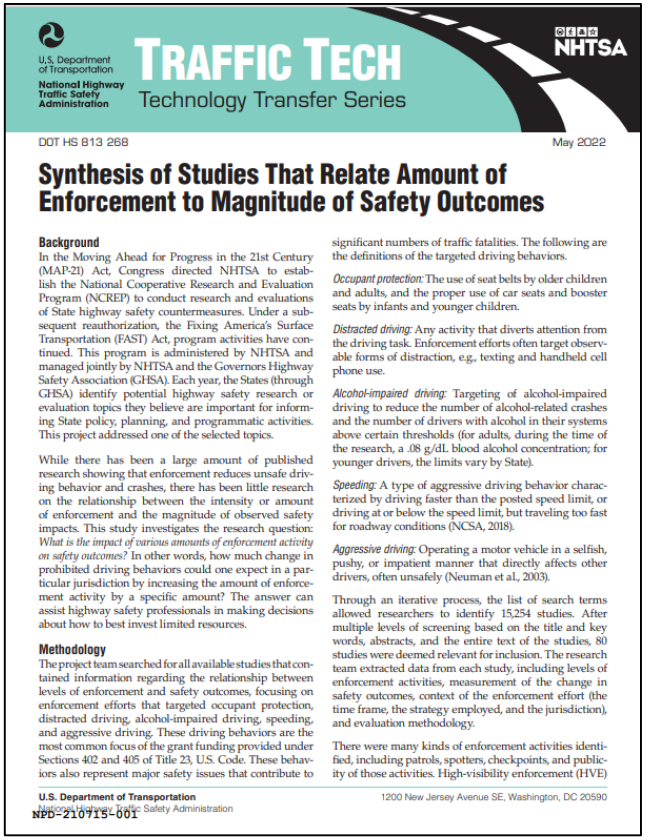
Education

Safe Users	Safe Speeds	Safe Roads	Safe Vehicles	Post-Crash Care
• Deliver CPS tech and instructor training and car seat check events. • Conduct community outreach events. • Conduct public information and education campaigns (e.g., print and broadcast materials and ads, related events). • Provide social media posts. • Deliver driver education/ training material support. • Carry out teen driver safety programs (e.g., Ford Driving Skills for Life, peer-to-peer initiatives). • Conduct older driver programs such as CarFit.	• Conduct pedestrian safety campaigns. • Conduct speed and aggressive driving communication campaigns (e.g., 100 days of summer). • Deliver educational messages and programs about the dangers of speeding and what we know about reductions in speed and survivability in the event of a crash.	• Educate on infrastructure improvements (e.g., roundabouts, bike lanes, HAWK signals) including how they improve safety and how to use them. • Offer LTAP training support.	• Educate on vehicle safety features (e.g., distracted driving warning, lane assist) through driver education and training. • Support education on connected and automated vehicles (CAV) and vehicle recalls.	• Deliver first responder training on incident management to clear the way for EMS and avoid secondary crashes. • Educate the public on their role when they come upon a crash scene. • Deliver educational messages and programs about how to provide post-crash care (bystander training).

Traffic Enforcement Matters



Traffic Enforcement Works



U.S. Department of Transportation
National Highway Traffic Safety Administration

TRAFFIC TECH
Technology Transfer Series

NHTSA

DOT HS 813 268 May 2022

Synthesis of Studies That Relate Amount of Enforcement to Magnitude of Safety Outcomes

Background

In the Moving Ahead for Progress in the 21st Century (MAP-21) Act, Congress directed NHTSA to establish the National Cooperative Research and Evaluation Program (NCREP) to conduct research and evaluations of State highway safety countermeasures. Under a subsequent reauthorization, the Fixing America's Surface Transportation (FAST) Act, program activities have continued. This program is administered by NHTSA and managed jointly by NHTSA and the Governors Highway Safety Association (GHSA). Each year, the States (through GHSA) identify potential highway safety research or evaluation topics they believe are important for informing State policy, planning, and programmatic activities. This project addressed one of the selected topics.

While there has been a large amount of published research showing that enforcement reduces unsafe driving behavior and crashes, there has been little research on the relationship between the intensity or amount of enforcement and the magnitude of observed safety impacts. This study investigates the research question: *What is the impact of various amounts of enforcement activity on safety outcomes?* In other words, how much change in prohibited driving behaviors could one expect in a particular jurisdiction by increasing the amount of enforcement activity by a specific amount? The answer can assist highway safety professionals in making decisions about how to best invest limited resources.

Methodology

The project team searched for all available studies that contained information regarding the relationship between levels of enforcement and safety outcomes, focusing on enforcement efforts that targeted occupant protection, distracted driving, alcohol-impaired driving, speeding, and aggressive driving. These driving behaviors are the most common focus of the grant funding provided under Sections 402 and 405 of Title 23, U.S. Code. These behaviors also represent major safety issues that contribute to significant numbers of traffic fatalities. The following are the definitions of the targeted driving behaviors.

Occupant protection: The use of seat belts by older children and adults, and the proper use of car seats and booster seats by infants and younger children.

Distracted driving: Any activity that diverts attention from the driving task. Enforcement efforts often target observable forms of distraction, e.g., texting and handheld cell phone use.

Alcohol-impaired driving: Targeting of alcohol-impaired driving to reduce the number of alcohol-related crashes and the number of drivers with alcohol in their systems above certain thresholds (for adults, during the time of the research, a .08 g/dL blood alcohol concentration; for younger drivers, the limits vary by State).

Speeding: A type of aggressive driving behavior characterized by driving faster than the posted speed limit, or driving at or below the speed limit, but traveling too fast for roadway conditions (NCSA, 2018).

Aggressive driving: Operating a motor vehicle in a selfish, pushy, or impatient manner that directly affects other drivers, often unsafely (Neuman et al., 2003).

Through an iterative process, the list of search terms allowed researchers to identify 15,254 studies. After multiple levels of screening based on the title and key words, abstracts, and the entire text of the studies, 80 studies were deemed relevant for inclusion. The research team extracted data from each study, including levels of enforcement activities, measurement of the change in safety outcomes, context of the enforcement effort (the time frame, the strategy employed, and the jurisdiction), and evaluation methodology.

There were many kinds of enforcement activities identified, including patrols, spotters, checkpoints, and publicity of those activities. High-visibility enforcement (HVE)

U.S. Department of Transportation
National Highway Traffic Safety Administration
1200 New Jersey Avenue SE, Washington, DC 20590

NPD-210115-001

https://bit.ly/3PocGhn

GHSA Governors Highway Safety Association The States' Voice on Highway Safety

Equity Recommendations

Inject equity into highway safety planning

- Traffic stop data collection
- Best practices guides for SHSOs
- Evidence-based preventative approaches

Refocus traffic enforcement on traffic safety

Engagement and representation

- Prioritize planning and investment in underserved communities
- Diverse representation in program planning
- Avoid making racial/socioeconomic problems worse

Report Recommendations

SHSOs

- Be a Safe System leader
- Establish expectations for addressing equity in planning and programs
- Show how behavioral safety already supports Safe System
- Promote safety culture

GHSA

- SHSO training
- Prepare SHSOs to engage diverse groups
- Highlight best practices

NHTSA

- Be a leader
- Provide guidance, state flexibility, best practices

Thank You

Eric Heitmann

Director

NJ Division of Highway Traffic Safety

Eric.Heitmann@njoag.gov

609-376-9717

RowanUniversity

CENTER FOR RESEARCH & EDUCATION IN
ADVANCED TRANSPORTATION ENGINEERING SYSTEMS

A Novel Approach to Identify Distracted Drivers: A Case Study in New Jersey

Dr. Mohammad Jalayer

Associate Professor

Department of Civil and Environmental Engineering

Associate Director of ITS, CREATEs

Rowan University

Outline

- Background
- Objectives
- Data Collection
- Event Data Analysis
- Video Analysis with Deep Learning
- Conclusions

Acknowledgement

❖ National Highway Traffic Safety Administration (NHTSA)

❖ Project Managers, New Jersey Division of Highway Traffic Safety (NJDHTS)

- Mr. Eric Heitmann
- Mr. Joseph Weiss
- Mr. Robert Gaydosh

❖Research Team

- Dr. Mohammad Jalayer (Principal Investigator & Associate Professor)
- Dr. Nidhal Bouaynaya (Co-Principal Investigator & Professor)
- Mr. Ahmed Sajid Hasan (Graduate Research Fellow)
- Mr. Deep Patel (Graduate Research Fellow)
- Ms. Ruqaya Alfaris (Graduate Research Fellow)
- Ms. Parisa Hosseini (Graduate Research Fellow)
- Ms. Zahara Vafakhah (Graduate Research Fellow)
- Ms. Anahita Kakhani (Graduate Research Fellow)

Acknowledgement

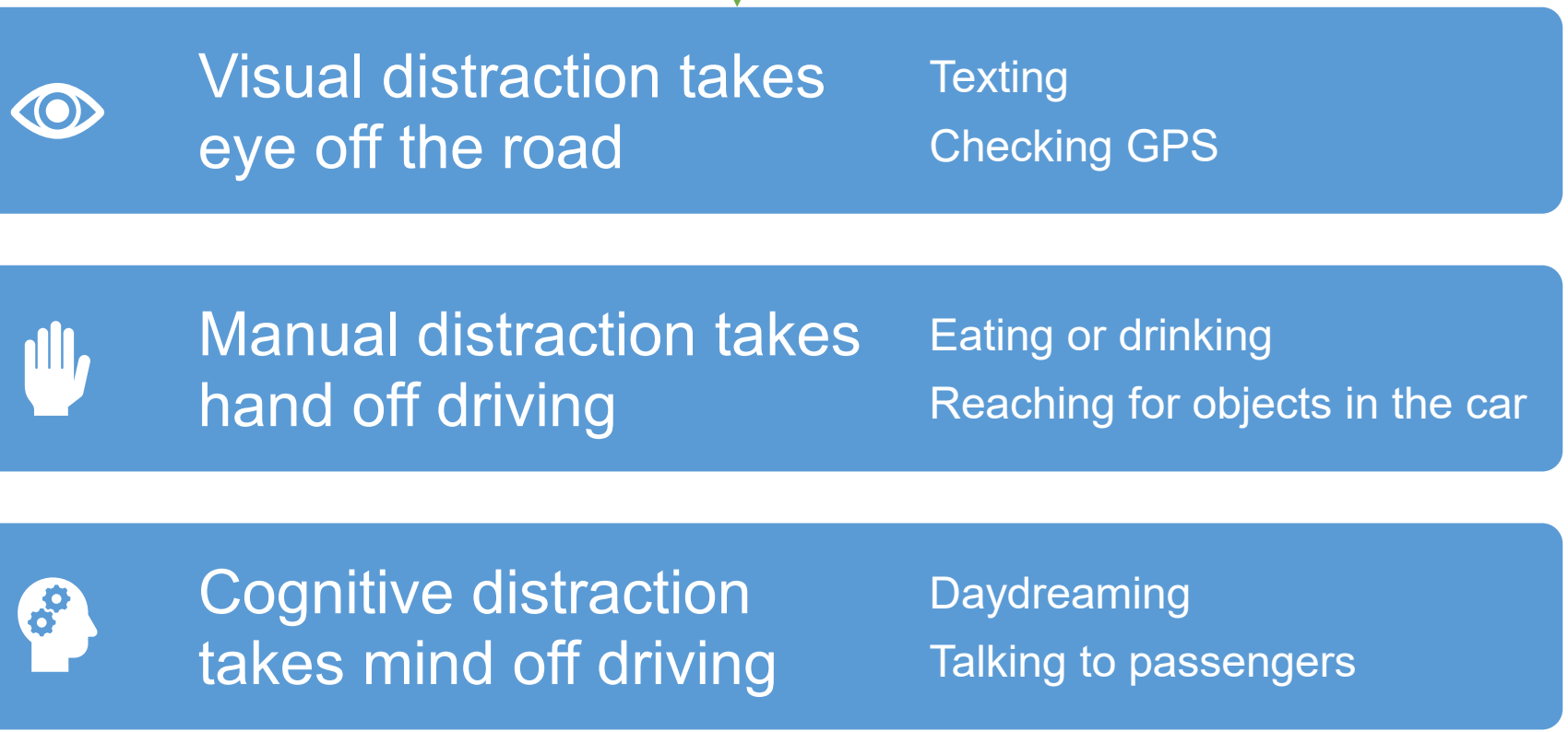
❖ Research Team

- Mr. Omar Alshiekyoussef (Undergraduate Student)
- Mr. Connor Mccarthy (Undergraduate Student)
- Mr. Imam Hasan Araf (Undergraduate Student)
- Mr. Nicolas Zugaib (Undergraduate Student)
- Mr. Alex Salazar (Undergraduate Student)
- Ms. Isabella Quimby (Undergraduate Student)

Background

"Anything that takes the drivers attention away from the task of safe driving is distracted driving" (NHTSA, 2012)

There are 3 main types of distracted driving (Regan, 2007)

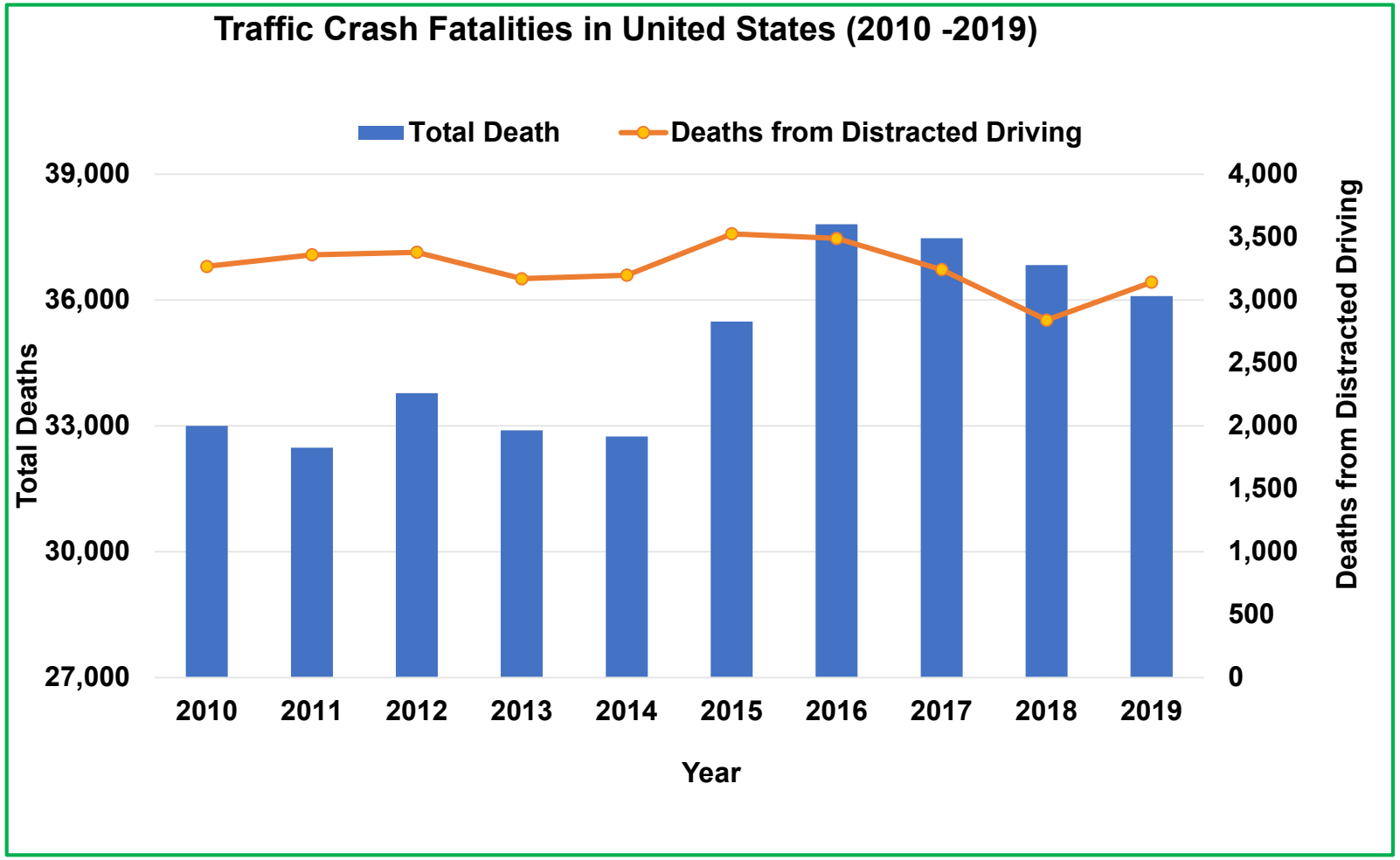


COMMON TASKS AS DISTRACTIONS

- Texting/Browsing
- Receiving phone calls
- Eating/Drinking
- Smoking
- Grooming/Fidgeting
- Turning Radio/GPS
- Reaching Objects
- Talking to Passenger
- Daydreaming
- Drowsy

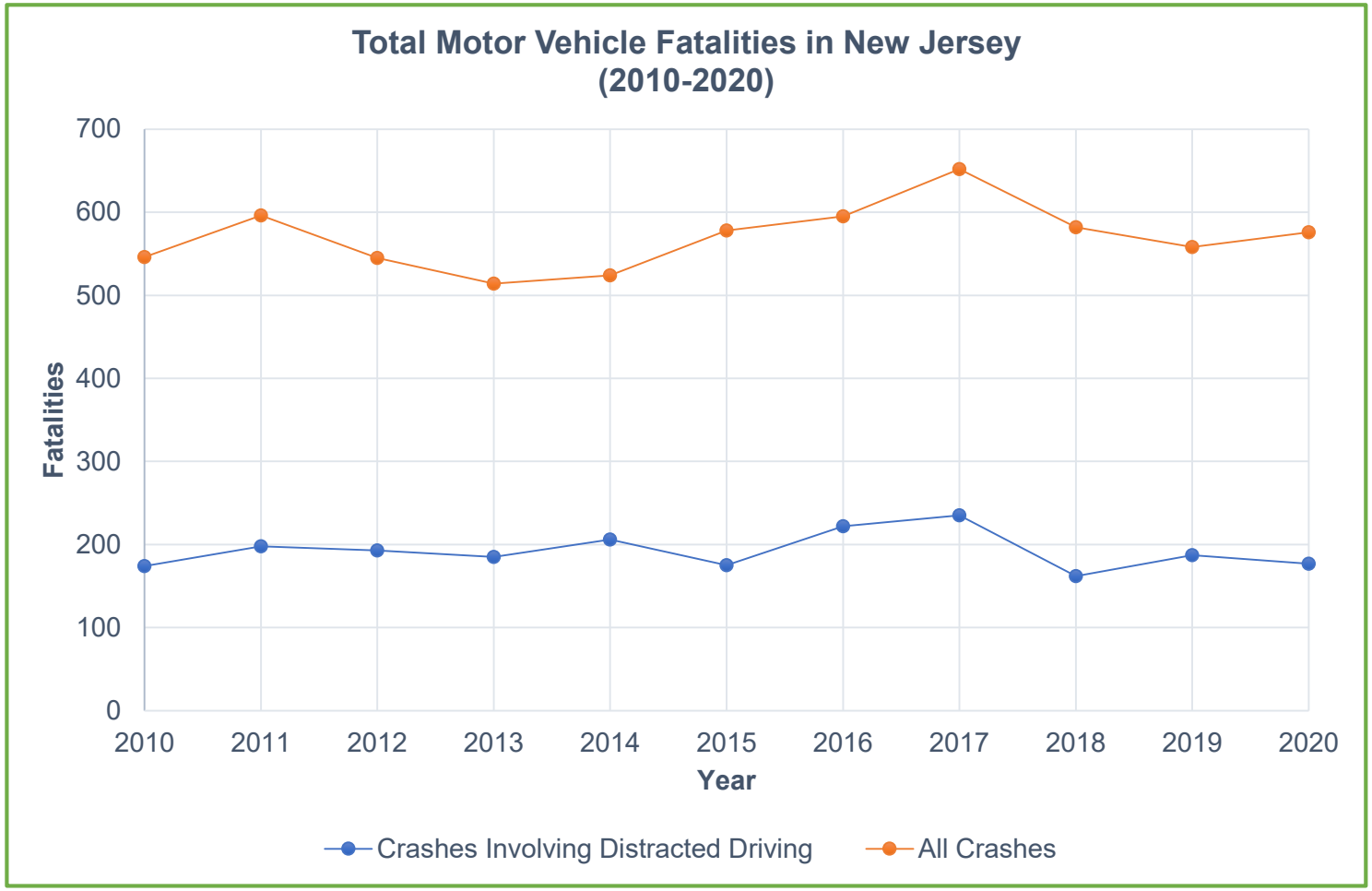
Background

- One of the top 5 causes of death in motor vehicle crash in USA (NHTSA, 2020).
- 3,142 fatalities and 424,000 injuries due to motor vehicle crashes involving distracted drivers in 2019 (NHTSA, 2020)



Background

- In NJ, distracted driving is the leading cause of fatal crashes
- 25% of the fatal motor vehicle crashes in the state
- Ranking second-highest among all the states

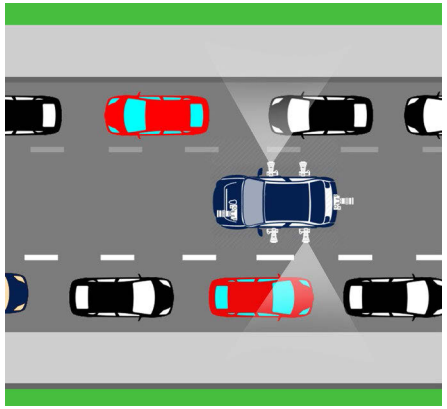


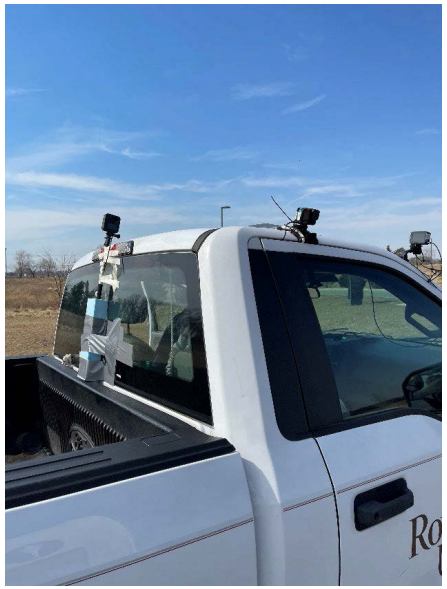
Objectives

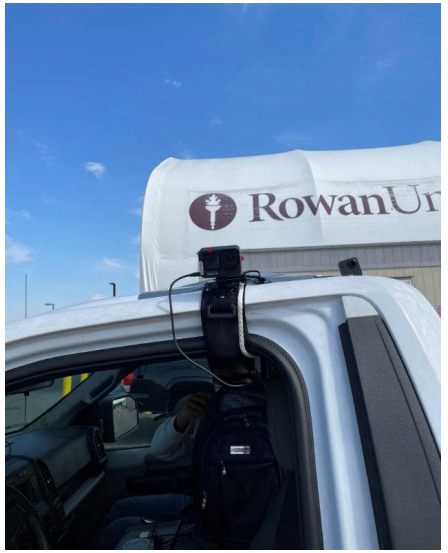
- Capture real-time driver behavior from on-road observation
- Detect the distracted drivers utilizing deep learning methods
- Analyze the impact of temporal features and roadway geometry on drivers' distraction behavior
- Develop recommendations and safety countermeasures

Data Collection Technique

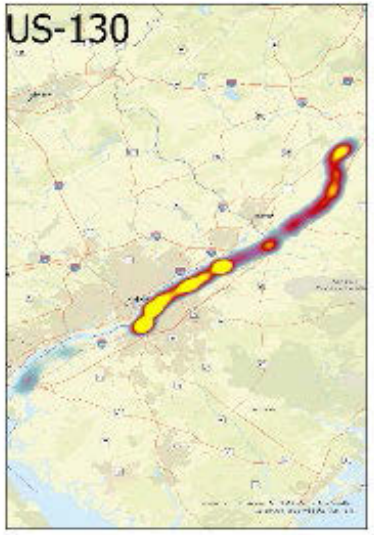
- Driver behavior is captured from **camera outside the vehicle**
- **Go Pro Hero 9** Cameras mounted on a moving vehicle
- Capturing driver's behavior at **60 frames per second** with a **resolution of 2704x1520**
- Collecting data continuously

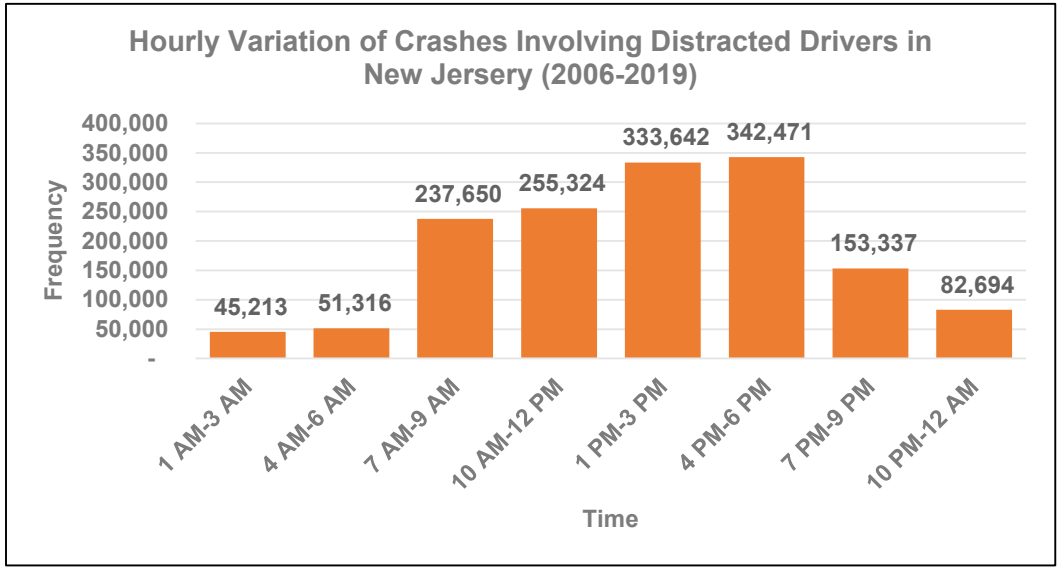


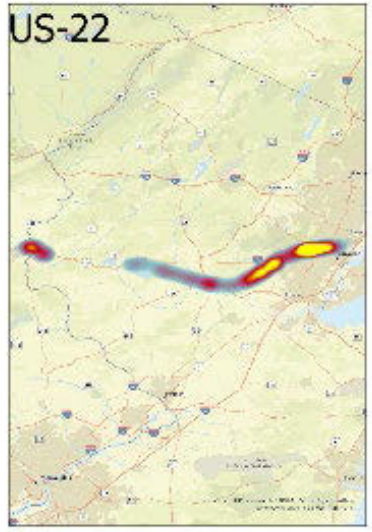




Data Collection (Corridor Selection)

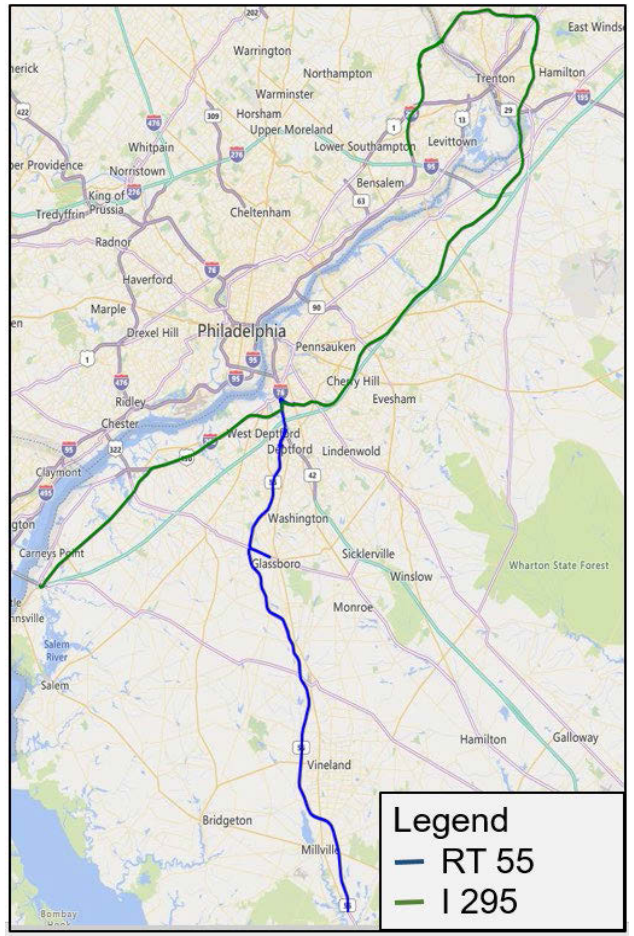




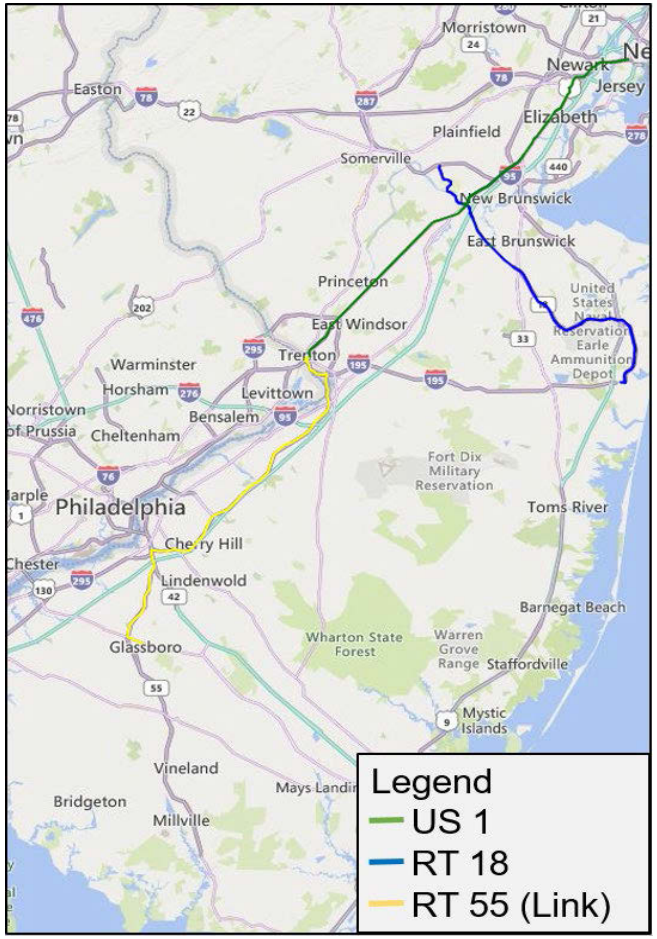


Location	% of Total Crash
US 1	2.85
Garden State Parkway	1.80
US 9	1.89
I-80	1.23
US 22	1.17
US 130	1.12
Source: NJDHTS; Years: 2006-2019	

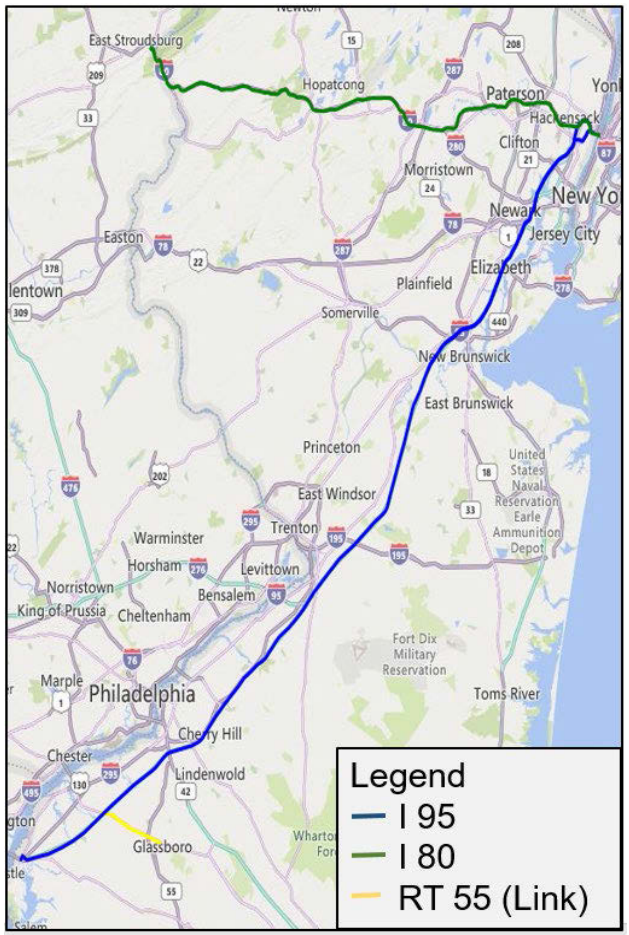
Data Collection (Corridor Selection)



I 295 & RT 55



RT 18



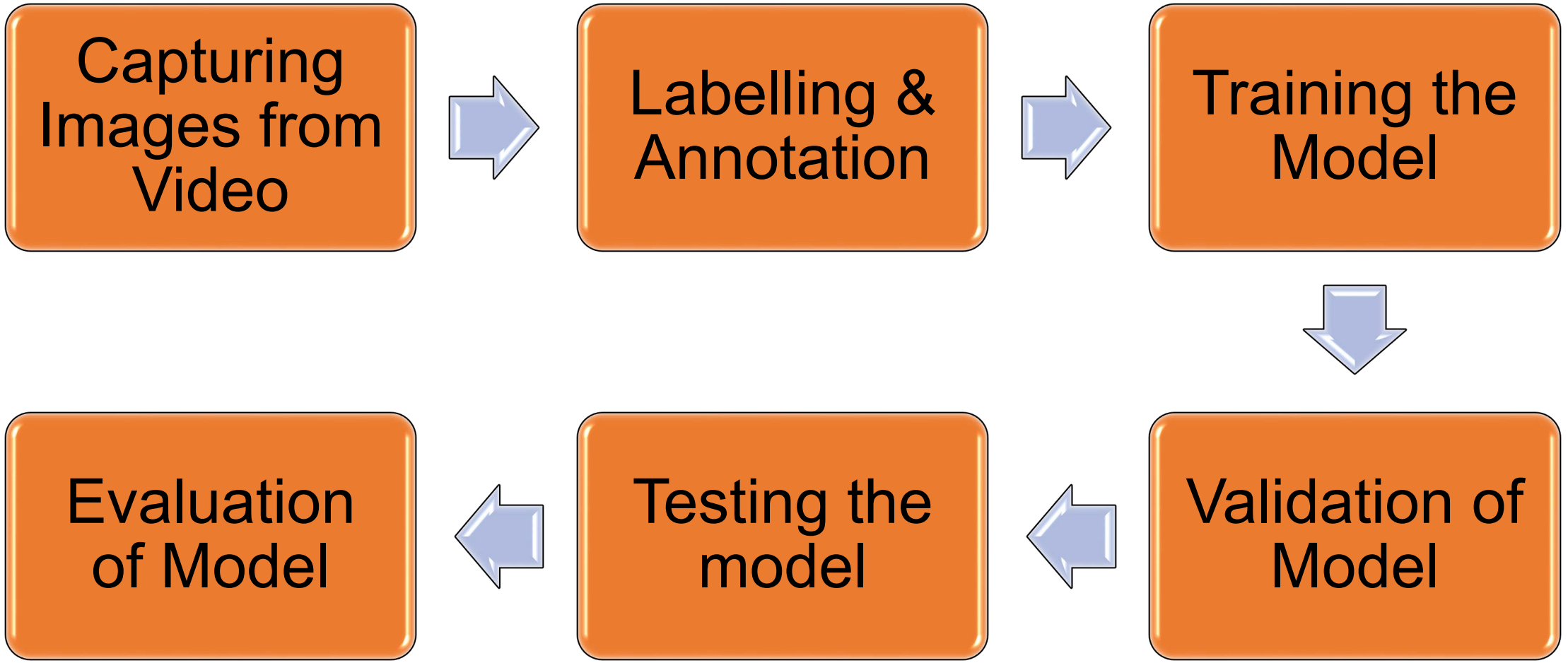
I 95

- Apart from the six high crash corridors, four important state and interstate corridors are also selected for data collection (I 95, RT 18, I 295 & RT 55)

Summary of Collected Data

Route	Signalized/ Unsignalized	Toll/ Non-Toll	Route Length in Miles (Round)	Total Miles of obs.	Total hours of obs.	AADT (2018)
RT-18	Signalized	Non-Toll	85.5	855	25	27,424
US-1	Signalized	Non-Toll	76	760	25	31,395
US-130	Signalized	Non-Toll	156	1560	40	22,653
US-9	Signalized	Non-Toll	106	1060	50	25,836
US-22	Signalized	Non-Toll	80	800	20	29,933
RT-55	Unsignalized	Non-Toll	127	1270	25	27,819
I-295	Unsignalized	Non-Toll	142	1420	25	50,378
I-80	Unsignalized	Non-Toll	135	1350	25	61,355
I-95	Unsignalized	Toll	234	2340	40	60,213
Parkway	Unsignalized	Toll	342	3420	60	102,941
Total			1,483.5	14,835	335	

Detailed Flowchart of Methodology for Detection of Distracted Driving



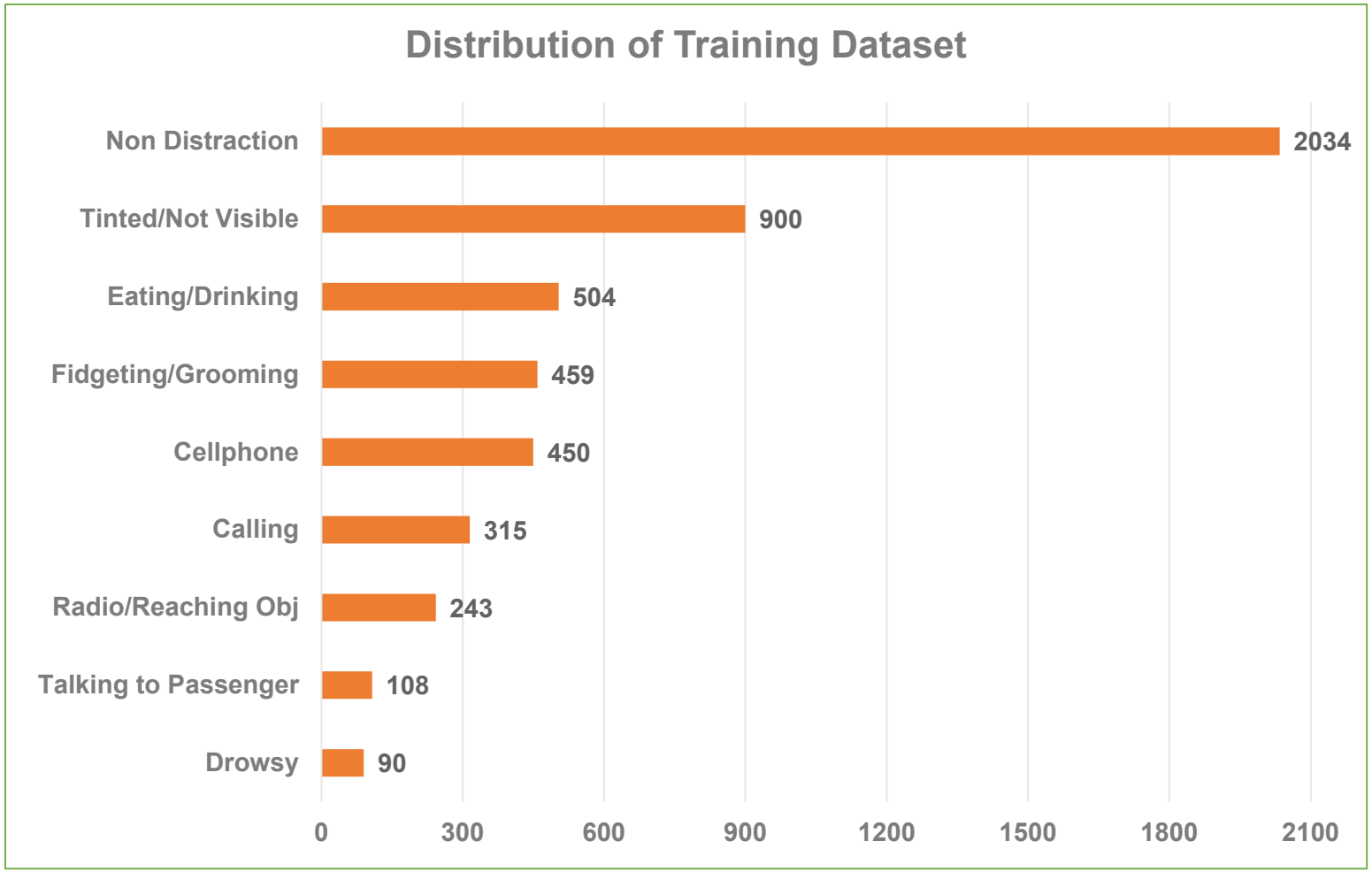
Detection Steps (Labelling and Annotation)

Definition of the labels

1. Handheld Cell Phone = **Hands** intersecting with **cellphone**
2. Receiving Calls = **Hands** intersecting with **cellphone** and **ear**
3. Food/Drink = **Hands** intersecting with **cup/food/cigarette**
4. Radio/Reaching Object = **Hands** intersecting with **radio**/any place on **dash**
5. Fidgeting/Grooming = **Hands** intersecting with **face**
6. Drowsy= **Hands** intersecting with **Mouth**
7. Talking to Passenger = **Eyes/Face** orientation is on the side of passenger
8. Non-Distracted = **Hands** intersecting with **Steering**
9. Tinted Window = Window black or glare

Detection Steps (Training Data)

- **5,670** images are considered for training purpose.
- The training of the model is done using an AI based algorithm: **YOLOv5.**
- Image size **640 x 640** and Batch size **16** was considered for training
- **300 epochs** taken to reduce overfitting and time of computation



Why YOLO?

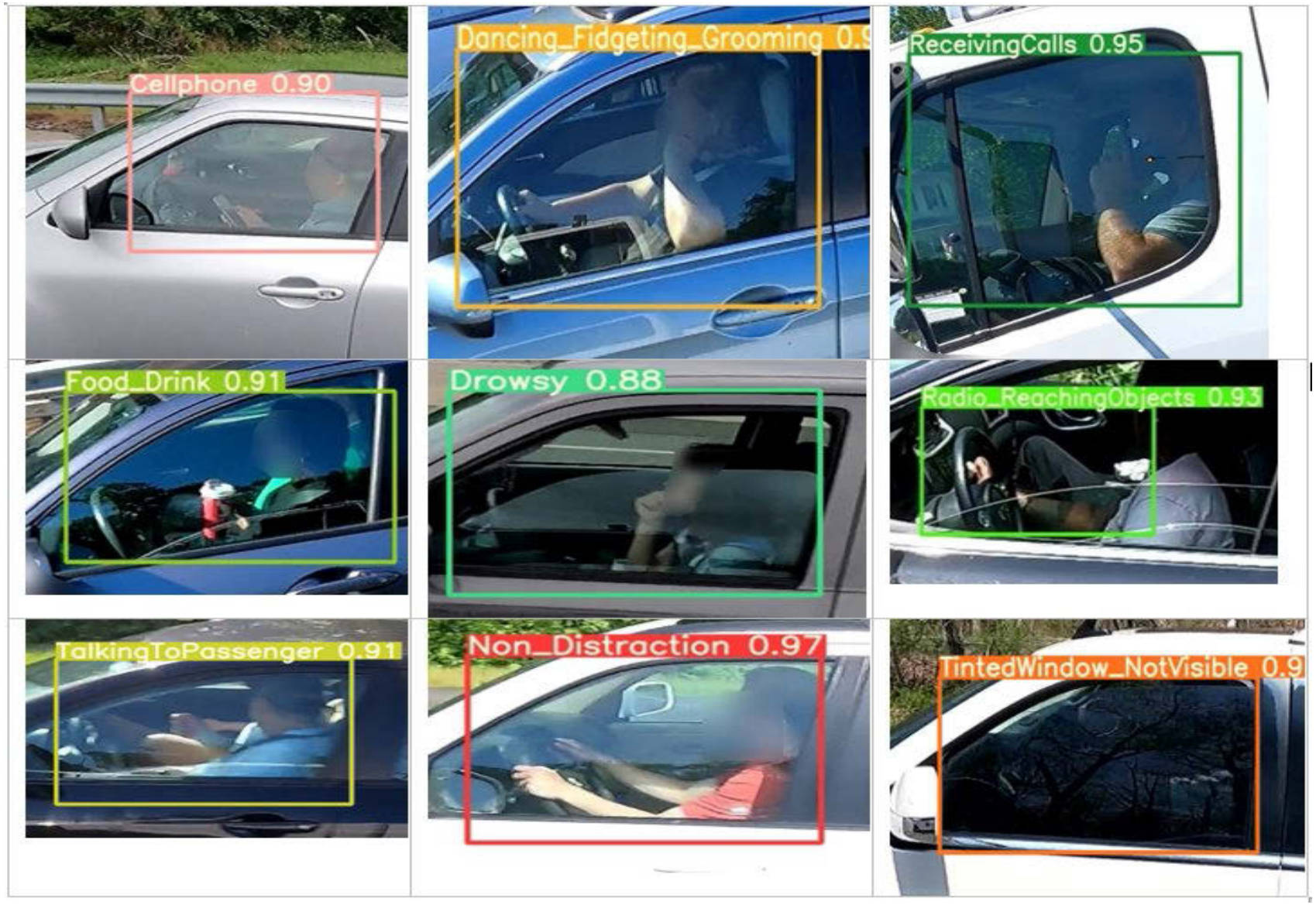
- Fast (Less duration for computation)
- Accurate in prediction
- Less requirement for GPU
- Batch/ parallel processing
- Good for training custom dataset

Detection Steps (Training & Validation of Data)

Training on a Batch of 16 images

Validation on a Batch of 16 images

Detection Steps (Testing)



- The name of the predicted type of distraction is shown above the bounding box
- The model also shows the confidence of the prediction (model is 90% confident that the first image is a cellphone)

Model Evaluation

Class	Non-Distraction	Cellphone	Tinted/ Not Visible	Fidgeting/ Grooming	Talking to Passenger	Radio/ Reaching Obj	Eating/ Drinking	Drowsy	Receiving Calls
Non-Distraction	**0.91**	0.10	0.10	0.16	0.33	0.30	0.23	0.20	0.11
Cellphone	0.00	**0.86**	0.00	0.04	0.00	0.00	0.00	0.00	0.00
Tinted/ Not Visible	0.05	0.00	**0.90**	0.04	0.00	0.00	0.00	0.00	0.00
Fidgeting/ Grooming	0.04	0.04	0.00	**0.76**	0.00	0.00	0.00	0.20	0.00
Talking to Passenger	0.00	0.00	0.00	0.00	**0.67**	0.00	0.00	0.00	0.11
Radio/ Reaching Obj	0.00	0.00	0.00	0.00	0.00	**0.70**	0.00	0.00	0.00
Eating/ Drinking	0.00	0.00	0.00	0.00	0.00	0.00	**0.77**	0.00	0.00
Drowsy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.60**	0.00
Receiving Calls	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.78**

Predicted

Actual

Summary of Distraction Events

Route	Handheld cell phone	Fidgeting/ Grooming	Eating/ Drinking	Radio/ Reaching Object	Talking To Passenger	Receiving Calls	Drowsy	Non-Distraction	Distraction Rate (%)
US-1	239	206	132	119	46	27	11	2310	25.2
RT-18	149	125	77	81	33	28	14	1670	23.3
US-130	332	243	221	134	59	46	15	3485	23.2
US-22	183	219	127	100	41	34	16	2433	22.8
I-95	338	249	193	183	73	69	21	3859	22.6
I-80	238	183	167	142	46	57	10	2916	22.4
Garden State Parkway	733	564	304	323	139	160	42	8084	21.9
I-295	189	194	130	117	65	44	12	2809	21.1
RT-55	97	68	38	35	20	15	3	1042	20.9
US-9	386	233	158	147	50	64	19	4147	20.3
Total	**2,884**	**2,284**	**1,547**	**1,381**	**572**	**544**	**163**	**32,755**	**22.3**

Summary of Distraction Rate (Temporal and Roadway Features)

Features	Category	Handheld cell phone	Fidgeting/ Grooming	Eating/ Drinking	Radio/ Reaching Object	Talking To Passenger	Receiving Calls	Drowsy	Non-Distraction	Distraction Rate (%)
Day of Week	Weekday	6.8	5.5	3.7	3.8	1.4	1.3	0.4	77.1	22.9
	Weekend	7.1	5.3	3.6	3.6	1.4	1.0	0.2	77.8	22.2
Hour of Day	Peak Hour	7.1	6.6	4.0	3.6	1.4	1.4	0.5	75.4	24.6
	Off-Peak Hour	6.6	5.3	3.7	3.7	1.2	1.1	0.4	78.0	22.0
Signalized/ Unsignalized	Signalized Road	7.2	6.0	3.9	3.6	1.2	1.0	0.4	76.7	23.3
	Unsignalized Road	6.7	4.8	3.4	3.8	1.6	1.4	0.3	78.0	22.0
Toll/Non-Toll	Toll Road	7.3	4.5	3.5	4.0	1.3	1.6	0.4	77.4	22.6
	Non-Toll Road	6.8	5.7	3.7	3.6	1.4	1.1	0.4	77.3	22.7
Season	Spring	6.7	4.5	3.0	3.6	1.5	1.2	0.3	79.2	20.8
	Summer	7.1	6.3	4.3	3.8	1.3	1.3	0.3	75.6	24.4
Median Width (ft.)	0-10	7.0	5.6	4.0	3.2	1.4	1.2	0.4	77.1	22.9
	11-20	7.1	5.4	3.2	3.2	1.1	1.4	0.3	78.3	21.7
	21-30	6.0	4.6	3.4	3.3	1.5	1.1	0.3	79.8	20.2
	30 or more	6.3	5.4	3.6	3.2	1.6	1.2	0.4	78.4	21.6

Summary of Distraction Rates (Roadway Features)

Features	Category	Handheld cell phone	Fidgeting/ Grooming	Eating/ Drinking	Radio/ Reaching Object	Talking To Passenger	Receiving Calls	Drowsy	Non-Distraction	Distraction Rate (%)
Type of Median	Unprotected	7.3	5.5	3	3.3	1.5	0.9	0.2	78.3	21.7
	Curbed	9.2	3.8	5.1	3.9	0.9	2.3	0.2	74.7	25.3
	Positive	6.6	5.2	3.9	3.7	1.4	1.3	0.3	77.5	22.5
No. of Lanes	2	8.2	5.6	3.1	3.3	1.2	0.9	0.2	77.4	22.6
	3	6.8	5.5	4	4.1	1.5	1	0.4	76.7	23.3
	4 or more	7.1	6.2	2.6	2.3	2	0.9	0.2	78.7	21.3
Posted Speed Limit (mph)	25-35 mph	3.7	10.1	3.1	5.4	3.1	0.5	0.3	73.9	26.1
	36-45 mph	7.2	5.5	3.4	3.4	1.4	1.2	0.7	77.1	22.9
	46-55 mph	6.2	5	3.3	2.9	1.1	1.6	0.4	79.3	20.7
	56-65 mph	6.6	4.7	3.9	4.1	1.4	1.3	0.3	77.8	22.2
Shoulder Width (ft.)	0-3'	7.5	6.4	3.8	3.3	1.0	1.0	0.4	76.7	23.3
	4'-6'	6.5	4.3	3.9	2.0	1.1	0.6	0.3	81.3	18.7
	7'-9'	7.0	4.3	3.1	3.0	0.9	1.5	0.5	79.8	20.2
	9‘ or more	6.6	5.4	3.6	3.2	1.5	1.2	0.3	78.1	21.9

Data Analysis (Statistical Tests)

Mann Whitney U Test	Kruskal Wallis Test
Non-parametric	Non-parametric
Not necessarily Normal distribution	Not necessarily Normal distribution
For comparison of 2 variables	For comparison of 3 or more variables
Statistically Significant at $P < 0.05$	Statistically Significant at $P < 0.05$ and H> Chi-squared value
There is no difference in mean rank between the samples drawn from two groups	There is no difference in mean rank between the samples drawn from different groups

Event Data Analysis (Weekday/Weekend)

Type of Distraction	Mean Rank Weekdays	Mean Rank Weekends	Delta Mean Rank	Mann-Whitney U	Z-score	P-Value
Fidgeting/Grooming	40.28	40.87	0.59	739.0	-0.10	0.92
Radio/Reaching Objects	44.46	33.9	-10.56	552.0	1.96	0.05*
Drowsy	42.87	36.55	-6.32	631.5	1.17	0.24
Talking to Passenger	40.17	41.05	0.88	733.5	-0.16	0.87
Receiving Calls	45.44	32.27	-13.17	503.0	2.45	0.01*
Eating/Drinking	41.78	38.37	-3.41	686.0	0.63	0.53
Handheld Cell Phone	41.22	39.3	-1.92	714.0	0.35	0.73
Non-Distracted	37.22	45.97	8.75	586.0	-1.62	0.11

* means statistically significant

Event Data Analysis (Signalized/Unsignalized Corridors)

Driver Behavior	Mean Rank Signalized Road	Mean Rank Unsignalized Road	Delta mean Rank	Mann-Whitney U	Z-score	P-Value
Fidgeting/Grooming	45.18	35.83	-9.35	613.0	1.79	0.07
Radio/ Reaching Objects	41.28	39.72	-1.56	769.0	0.29	0.77
Drowsy	43.19	37.81	-5.38	692.5	1.03	0.30
Talking to Passenger	37.08	43.92	6.84	663.0	-1.31	0.19
Receiving Calls	35.45	45.55	10.1	598.0	-1.93	0.05
Eating/Drinking	45.75	35.25	-10.5	590.0	2.02	0.04*
Handheld Cell Phone	44.12	36.88	-7.24	655.0	1.39	0.16
Non-Distracted	35.98	45.02	9.04	619.0	-1.74	0.08

* means statistically significant

Event Data Analysis (Spring/Summer)

Driver Behavior	Mean Rank Spring	Mean Rank Summer	Delta mean Rank	Mann-Whitney U	Z-score	P-Value
Fidgeting/Grooming	28.83	47.14	18.31	401.0	3.38	0.00*
Radio/Reaching Objects	45.55	37.63	-7.92	593.0	-1.46	0.14
Drowsy	36.81	42.60	5.79	632.5	1.07	0.28
Talking to Passenger	41.07	40.18	-0.89	723.0	-0.16	0.87
Receiving Calls	38.17	41.82	3.65	672.0	0.67	0.50
Eating/Drinking	27.38	47.96	20.58	359.0	3.80	0.00*
Handheld Cell Phone	41	40.22	-0.78	725.0	-0.14	0.89
Non-Distracted	50.86	34.61	-16.25	439.0	-3.00	0.00*

* means statistically significant

Event Data Analysis (Toll Road/Non-Toll Road)

Driver Behavior	Mean Rank Toll Road	Mean Rank Non-toll Road	Delta mean Rank	Mann-Whitney U	Z-score	P-Value
Fidgeting/Grooming	36.56	41.48	4.92	449.0	0.75	0.45
Radio/Reaching Objects	39.78	40.68	0.9	500.5	0.13	0.90
Drowsy	47.34	38.79	-8.55	402.5	-1.31	0.19
Talking to Passenger	43.5	39.75	-3.75	464.0	-0.57	0.57
Receiving Calls	50.62	37.97	-12.65	350.0	-1.94	0.05
Eating/Drinking	33.12	42.34	9.22	394.0	1.41	0.16
Handheld Cell Phone	42.06	40.11	-1.95	487.0	-0.29	0.77
Non-Distracted	42.06	40.11	-1.95	487.0	-0.29	0.77

* means statistically significant

Event Data Analysis (Peak Hour/Off-Peak Hour)

Driver Behavior	Mean Rank Peak Hour	Mean Rank Off-Peak Hour	Delta mean Rank	Mann-Whitney U	Z-score	P-Value
Fidgeting/Grooming	69.72	68.31	-1.41	2297	-0.20	0.84
Radio/Reaching Objects	67.30	70.63	3.33	2231	0.62	0.49
Drowsy	69.19	68.82	-0.37	2332.5	-0.05	0.96
Talking to Passenger	72.60	65.56	-7.04	2104	-1.04	0.30
Receiving Calls	73.54	64.66	-8.88	2041	-1.30	0.19
Eating/Drinking	72.90	65.27	-7.63	2084	-1.12	0.26
Handheld Cell Phone	70.28	67.77	-2.51	2259	-0.37	0.71
Non-Distracted	64.62	73.19	8.57	2051.5	1.26	0.21
* means statistically significant						

Pairwise Comparison for Speed Limit

Type of Distraction	Mean Rank Values				Direction of Significance (↑ for increase, ↓ for decrease)					
	Posted Speed Limit (mph)									
	25-35	35-45	45-55	55-65	25-35 vs. 35-45	25-35 vs. 45-55	25-35 vs. 55-65	35-45 vs. 45-55	35-45 vs. 55-65	45-55 vs. 55-65
Handheld Cell Phone	100	157.2	214.2	170.7	↑	↑	↑	-	↑	↓
Fidgeting/Grooming	117.5	148.3	211.3	164.9	↑	↑	↑	↑	-	↓
Radio/Reaching Objects	123.9	145.0	196.3	176.9	↑	↑	↑	↑	↑	-
Eating/Drinking	104.1	146.3	210.4	181.2	↑	↑	↑	↑	↑	-
Talking to Passenger	109.1	148.3	202.8	181.8	↑	↑	↑	↑	↑	-
Receiving Calls	104.7	146.1	204.8	186.5	↑	↑	↑	↑	↑	-
Drowsy	128.7	150.9	188.1	174.3	↑	↑	↑	↑	-	-
Non-Distracted	114.1	136.8	226.2	165.0	↑	↑	↑	↑	↑	↓

Pairwise Comparison for No. of Lanes

Type of Distraction	Mean Rank Values			Direction of Significance (↑ for increase, ↓ for decrease)		
	Number of Lanes					
	2	3	4 or more	2 vs. 3	2 vs. 4 or more	3 vs. 4 or more
Handheld Cell Phone	142.8	128.3	90.4	-	↓	↓
Fidgeting/Grooming	133.7	134.7	93.1	-	↓	↓
Radio/Reaching Objects	131.0	144.5	86.0	-	↓	↓
Eating/Drinking	131.5	140.2	89.9	-	↓	↓
Talking to Passenger	126.7	143.9	90.9	-	↓	↓
Receiving Calls	125.5	140.0	96.0	-	↓	↓
Drowsy	119.3	141.8	100.5	↑	↓	↓
Non-Distracted	139.8	109.0	112.6	↓	↓	-

Pairwise Comparison for Median Type

Type of Distraction	Mean Rank Values			Direction of Significance (↑ for increase, ↓ for decrease)		
	Median Type					
	Unprotected	Positive	Curbed	Unprotected vs Positive	Unprotected vs Curbed	Positive vs Curbed
Handheld Cell Phone	115.9	161.1	84.4	↑	↓	↓
Fidgeting/Grooming	127.3	149.8	84.4	↑	↓	↓
Radio/Reaching Objects	117.8	153.4	90.3	↑	↓	↓
Eating/Drinking	117.1	156.6	87.8	↑	↓	↓
Talking to Passenger	123.5	152.2	85.8	↑	↓	↓
Receiving Calls	115.9	161.1	84.4	↑	↓	↓
Drowsy	110.6	153.6	97.3	↑	-	↓
Non-Distracted	127.1	143.4	91.0	↑	↓	↓

Pairwise Comparison for Median Width

Type of Distraction	Mean Rank Values				Direction of Significance (↑ for increase, ↓ for decrease)					
	Median Width (ft.)									
	0-10	11-20	21-30	>30	0-10 vs. 11-20	0-10 vs. 21-30	0-10 vs. >30	11-20 vs. 21-30	11-20 vs. >30	21-30 vs. >30
Handheld Cell Phone	178.0	161.0	128.1	166.9	-	↓	-	↓	-	↑
Fidgeting/Grooming	178.8	172.2	119.8	163.2	-	↓	-	↓	-	↑
Radio/Reaching Objects	178.0	161.1	133.8	161.1	-	↓	-	↓	-	-
Eating/Drinking	183.8	159.8	127.9	162.5	-	↓	-	↓	-	↑
Talking to Passenger	181.6	153.2	142.2	157.0	↓	↓	-	-	-	-
Receiving Calls	183.6	155.4	135.3	159.6	-	-	↓	-	-	-
Drowsy	186.5	160.2	138.4	149.0	↓	↓	↓	↓	-	-
Non-Distracted	173.2	154.4	146.2	160.2	-	-	-	-	-	-

Pairwise Comparison for Shoulder Width

Type of Distraction	Mean Rank Values				Direction of Significance (↑ for increase, ↓ for decrease)					
	Shoulder Width (ft.)									
	0-3	4-6	7-9	>9	0-3 vs. 4-6	0-3 vs. 7-9	0-3 vs. >9	4-6 vs. 7-9	4-6 vs. >9	7-9 vs. >9
Handheld Cell Phone	154.3	139.0	138.2	202.6	-	-	↑	-	↑	↑
Fidgeting/Grooming	155.7	138.5	131.7	208.1	-	-	↑	-	↑	↑
Radio/Reaching Objects	157.1	128.8	136.3	211.8	↓	-	↑	-	↑	↑
Eating/Drinking	156.1	129.9	135.2	212.8	↓	-	↑	-	↑	↑
Talking to Passenger	149.0	127.9	123.1	234.0	↓	↓	↑	-	↑	↑
Receiving Calls	155.5	124.5	135.2	218.8	↓	-	↑	-	↑	↑
Drowsy	155.9	134.8	138.7	204.5	↓	-	↑	-	↑	↑
Non-Distracted	155.3	147.1	138.5	193.1	-	-	↑	-	↑	↑

Conclusions

- Receiving calls significantly increased during weekdays, while eating/drinking significantly increased during summer and in signalized roads
- An increase of speed limit from 25-35 mph to 55-65 mph significantly increased the number of distractions
- 4 or more lane significantly decreased distraction than 2 and 3 lane roads
- An increase in shoulder width significantly increased distractions
- Accuracy of the model is 85.01%

Thank You