Traffic Safety Changes During the COVID-19 Public Health Emergency in California, Louisiana, Massachusetts, and Ohio

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Abstract

The COVID-19 public health emergency's changes to commute behavior affected traffic safety of road users in California, Louisiana, Massachusetts, and Ohio in 2020. For every vehicle-mile traveled, road users were less likely to be involved in a collision or injury collision, but more likely be involved in a fatal collision.

Examining each state's traffic safety data at monthly intervals, reported collisions and injury collisions per VMT decreased from the previous year for all states observed at the start of the public health emergency. Fatal collisions per VMT increased for nearly all states throughout the observed time period, but California and Louisiana's increases occurred mostly during the start of the public health emergency, while Massachusetts and Ohio had significant increases throughout the time span observed. Traffic safety changes were found to be correlated with statewide pandemic restriction levels, and states with safer transportation systems before the pandemic had safer transportation systems during the pandemic.

Introduction

The COVID-19 pandemic impacted transportation systems throughout the country, as many commuters shifted to telecommuting or lost their employment. This change in road use has altered traffic safety patterns. Analyses by transportation technology companies and state Departments of Transportation have indicated that drivers are driving faster (Pishue, 2020, Lazo 2020) and breaking harder (Zendrive 2020). These changes in behavior have significant safety impacts, with significant increases in motor vehicle fatality rates per mile driven when compared to the previous year in May of 2020 (Chadra 2020).

The traffic safety impacts of the COVID-19 Pandemic will be examined for four different states: California, Louisiana, Massachusetts, and Ohio. By comparing statewide trends in fatal, injury, and total collision per vehicle-mile-traveled (VMT) data, this paper will attempt to identify changes in traffic safety related to the pandemic and determine their heterogeneity across states. Despite differences across states in general traffic safety and responses to the pandemic existing, they are not be treated as immutable. Applying a Safe Systems approach to road safety, this paper will analyze these changes as products of their respective transportation systems and consider heterogenous effects of the pandemic as indicators of the need for higher quality traffic safety infrastructure and programs.

Existing Traffic Safety Analysis

Governmental agencies and private companies collected and analyzed traffic safety data throughout the duration of the public health emergency.

The National Highway Traffic Safety Administration (NHTSA), an agency in the U.S. Department of Transportation, publishes traffic safety reports for every quarter of the year using data submitted by state transportation agencies. NHTSA has noted several substantial changes in traffic safety data since the start of the pandemic. Compared to 2019, there were "31% few trips per day in Q2 2020 and 35% fewer trips in Q3 2020" (Office of Behavioral Safety Research, 2021). Risky behaviors, including failure to use seat belts, failure to adhere to speed limits, and driving under the influence, all increased after the start of the public health emergency. Increases in vehicle velocity has not been uniform spatially. Using the National Performance Management Research Data Set (NPMRDS), NHTSA observed significant increases in urban road speeds from April to June (NHTSA, 2020) and July to September (Office of Behavioral Safety Research, 2021).

The National Safety Council (NSC), an American nonprofit safety advocate, tracks automobile fatality trends and issues traffic safety data estimates regularly. In July, the NSC stated that that the fatality rate per miles driven in May increased by 23.5% in comparison to 2019 (NSC, 2020a), from 1.19 to 1.47 deaths per 100 million vehicle miles. The total number of deaths on the road in May dropped an estimated 8% from 2019, but the number of miles driven that month dropped 25.5%. In November 2020, the NSC published preliminary monthly traffic safety estimates for the first eleven months of the year. Over this time period, seven states had an increase in traffic fatalities of more than 100 deaths: Texas, California, North Carolina, Florida, Arkansas, Mississippi, and Missouri (NSC, 2020b).

Zendrive, a telemetrics company with access to millions of miles of driving data from their phone application, also analyzed changes in driving behavior after the start of the public health emergency. From analysis of behavioral data in the weeks before and after March 15th, the date of the first stay-in-place order, Zendrive discovered a 27% increase in speeding, 38% increase in phone usage, and 25% increase in hard braking in drivers still on the road (Zendrive 2020).

In a report for the analytics company INRIX, Bob Pishue analyzed road conditions on major thoroughfares in the U.S.'s 25 largest metropolitan areas in "COVID-19 Effect on Collisions on Interstates and Highways in the US." Incidences of collisions were found to have fallen across all analyzed metro areas, then returned to pre-COVID 19 levels between August and October. During this period, instances of collisions grew significantly more than VMT (57% increase in collisions to 22% in VMT). In addition to analysis on overall collision and VMT trends, this report examined differences in collision trends for different functional classifications for roadways. Collisions were found to vary significantly based on the functional classification, with 14 of the 25 metro areas with "greater percentage decreases in collisions on arterial streets than on Interstates and freeways/expressways."

Data

The traffic safety time series data will be analyzed of four states: California, Louisiana, Massachusetts, and Ohio. Selection of states was based off of available data and different vehicular trends in response to the pandemic. An analysis by Streetlight indicated that California and Massachusetts had larger reductions in VMT that did not recover quickly, while Louisiana and Ohio had lower VMT reductions that recovered more quickly (Wegsheider, 2020). The data for California is provided by the Statewide Integrated Traffic Records System (SWITRS), a database updated by the California Highway Patrol. Louisiana's data is provided by the Louisiana State University in Crash Reports. Massachusett's data is provided by the Massachusetts DOT in their "Crash Open Data Portal." Ohio's data is provided by the Ohio Department of Public Safety through their Ohio Crash Statistics System.

Massachusetts and Louisiana provide statewide traffic safety data aggregated for every month. California and Ohio provide crash reports for every traffic incident. The data for California and Ohio was therefore processed using the programming language Python to produce comparable aggregates.

Methodology

Raw traffic safety data lacks required contextual information to understand traffic safety changes during the pandemic. For example, a reduction in total statewide traffic incidents may give the indication that road safety during this time period has increased; however, if the total number of miles driven in the state also decreased, the effect of the pandemic on traffic safety becomes less clear. Therefore, estimates of state-level vehicle miles traveled (VMT) data reported in monthly increments by the Federal Highway Administration (FHWA) are used as a denominator to contextualize changes in traffic safety. This is equivalent to "exposure" data in the field of public health.

The monthly VMT, fatal collision, injury collision, and total collision data of each state during the pandemic was compared to the data of previous years and to other states in this analysis. Comparing year-to-year monthly data is superior to comparing data from one month to another to avoid typical monthly and seasonal trends (e.g., VMT is typically higher in summer months than winter months). Although Ohio and California provide data differentiating serious injury and less serious injury collisions, Louisiana and Massachusetts do not. Therefore, these categories were combined when provided. In this analysis, fatal collisions result in at least one fatality and injury collisions result in at least one injury, but no fatalities. These groups are mutually exclusive. Fatal collisions may result in multiple fatalities or injuries, and injury collisions may result in multiple injuries. Parties involved in the collision datasets include pedestrians or bicyclists involved in a vehicular collision, therefore, injuries or deaths of these two groups are included in the data.

Timeline of Restrictions in Each State

California, Louisiana, Massachusetts, and Ohio state governments initial responses to the pandemic were similar. Many of these responses affected vehicular travel. Both public and

private schools closed mid-March and remain closed until the end of the 2019-2020 school year (Ballotpedia, e). From March 19th to March 22nd, after initial restrictions, the four issued stay-at-home advisories or orders (National Governor's Association, 2020 a-d). Beginning in May, states would begin to allow the reopening of certain businesses under restrictions. Around this time period, the states would release reopening plans that determined county eligibility based on county-level criteria. The states would then loosen or tighten restrictions based off of case rates throughout summer. Many restrictions were lifted or issued on a county level (National Governors Association, 2020a-d).

School reopening in Fall 2020 for Massachusetts, Ohio, and Louisiana varied at the local level, while the California state government imposed a partial closure (Ballotpedia, a). On September 11th, the California state government announced 414 k-6 schools received a waiver to reopen. All four states would remain at levels of restrictions until late November, when a resurgence of COVID-19 cases occurred (Ballotpedia, a-d).

Comparing the stringency of public health emergency government restrictions is complicated by the differences in local implementation. For the purpose of comparison between states, generalizations were required. Using data from the COVID-19 Government Response Tracker created and updated by Oxford's Blavatnik School of Government, the New York Times created visualizations detailing the overall response of different states' governments (Leatherby & Harris, 2020). California and Massachusetts are considered to have put into place very strict containment measures since the initial closures in March until the publication of the article in mid-November. Ohio was considered to have reasonably strict measures, with certain relaxations. The measure stringency index would for Ohio would fall during the start of the 2020-2021 school year. Louisiana is considered to have a government response level that puts it in the center, with a predominantly average response rating from March to mid-November.

Vehicle Miles Traveled Changes During the Pandemic

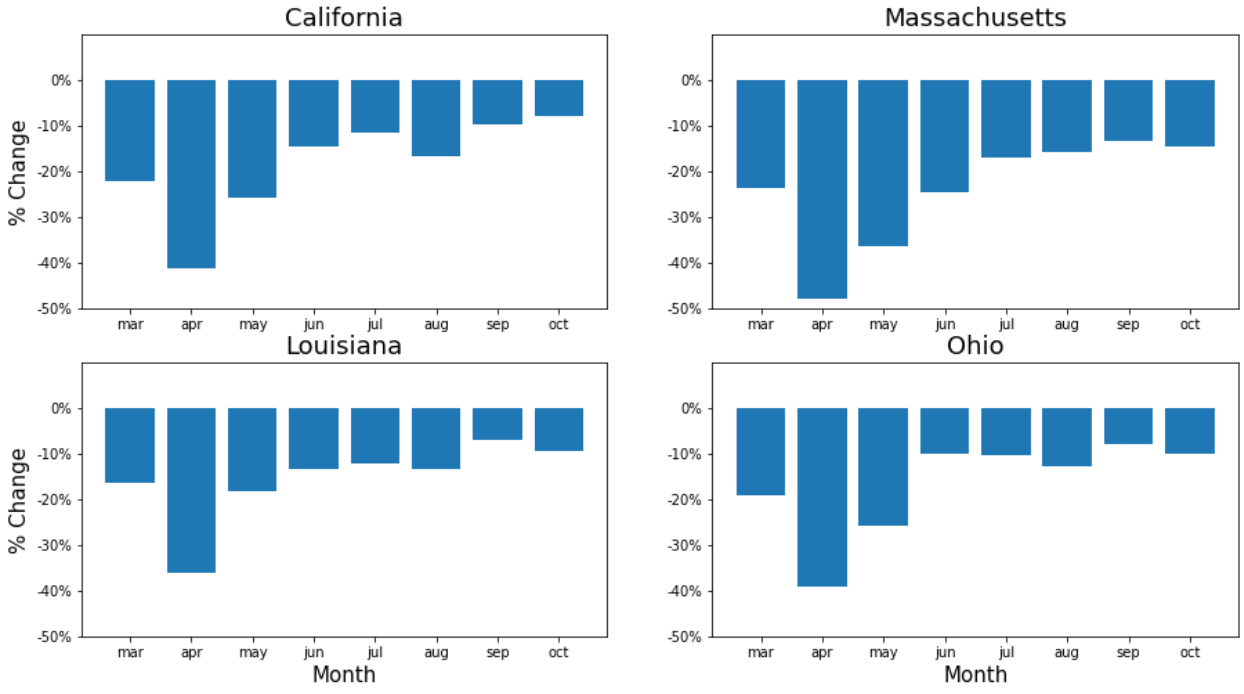
Individual states' VMT data for 2018, 2019, and 2020 was taken from the FHWA's Traffic Volume Trends monthly reports (FHWA). The data is derived from hourly traffic data from traffic counting locations. Examining the FHWA data, all four states' VMT decreased significantly from 2019 to 2020 from the months of March to October, as shown in Table 1.

Table 1: VMT (in 100 Millions) Changes from March to October

	California		Louisiana		Massachusetts		Ohio	
Year	**VMT***	**% Change**	**VMT***	**% Change**	**VMT***	**% Change**	**VMT***	**% Change**
2018	2339.2	-	340.6	-	429.9	-	818.2	-
2019	2400.3	2.6%	350.0	2.8%	461.8	7.4%	787.1	-3.8%
2020	1950.2	-18.8%	295.2	-15.7%	352.2	-23.7%	654.4	-16.9%

All four states experienced similar monthly trends in VMT reductions compared to the previous year. VMT decreased in March 2020 from March 2019 by 15-20%, hit a nadir in April with reductions from 35-50%, then gradually returned to values from 10-20% lower than the previous year until October. This reflects state-level restrictions: states initiated economic and state service shutdowns in March and began the process of loosening them in May, after April had passed.

Figure 1: VMT Percent Changes from 2019 to 2020 by Month



Issue Analysis

All Collisions

The four states analyzed have different relationships between reported collisions and VMT. California's reported collisions per VMT is lower than other states, indicating that drivers tend to become involved in vehicular collisions less per vehicle-mile driven. Traffic safety per trip would have to be determined using a different metric – typical California vehicle trips could tend to be longer than the other states examined.

Changes in the total number of collisions per VMT from 2018 to 2019 from March to October varied across the states, with Ohio experiencing a slight increase in reported collisions per VMT and California, Louisiana, and Massachusetts experiencing decreases, as shown in Table 2.

From 2019 to 2020, however, all states experienced decreases in reported collisions per VMT despite significant reductions in VMT in 2020. California and Massachusetts experienced greater than 10% reductions in reported collisions per VMT, while Louisiana and Ohio experienced more modest reductions.

Table 2: All Collisions per 100 Million VMT from March to October

	California			**Louisiana**			**Massachusetts**			**Ohio**		
Year	**Total**	**per VMT***	**% Change**	**Total**	**per VMT***	**% Change**	**Total**	**per VMT***	**% Change**	**Total**	**per VMT***	**% Change**
2018	324757	1115.0	-	108534	2572.8	-	91168	1698.3	-	195038	1911.2	-
2019	314908	1053.4	-5.5%	110002	2530.9	-1.6%	92160	1598.2	-5.9%	195056	1983.3	3.8%
2020	228291	938.0	-11.0%	88084	2377.2	-6.1%	60133	1360.3	-14.9%	152716	1852.0	-6.6%

Comparing reported collisions per VMT percentage reductions from 2019 to 2020 on a monthly basis reveal different collision changes for each state. California and Massachusetts experienced uniformly negative changes in collisions per VMT from March to October. However, Massachusetts experienced reductions greater than 15% from March to May, while California's reductions were less substantial. Louisiana experienced significant reductions in March, April, and May, but had a significant percentage increase in the month of July. Ohio's greatest reductions also occurred predominantly earlier in the time span examined, but were less substantial.

Figure 2: All Collisions Change from 2019 to 2020 by Month

Injury Collisions

Comparing the relationship between injury collisions and VMT across the states, Louisiana tends to experience significantly higher injury collisions per vehicle-mile traveled than the other states, with approximately 700 injury collisions per 100 million vehicle-mile traveled from 2018 to 2020 in the months of March to October.

Examining percentage changes, California and Massachusetts are similar in that injury collisions per VMT decreased 5.1% and 4.3% respectively from 2018 to 2019 and decreased approximately 14% from 2019 to 2020. Louisiana experienced a .9% increase from 2018 to 2019 and a 4.2% decrease from 2019 to 2020. Ohio is unlike the other states in that injury collisions per VMT increased almost 8% from 2018 to 2019, then only decreased 1% from 2019 to 2020.

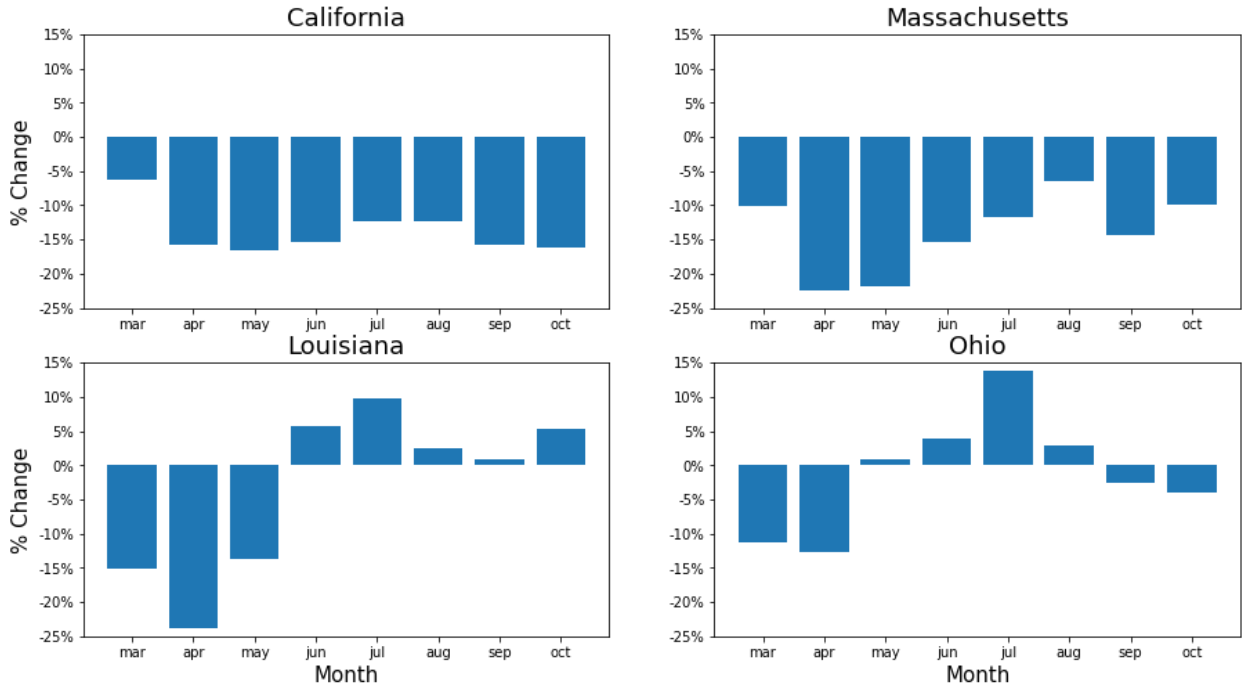
Table 3: Injury Collisions per 100 Million VMT from March to October

	California			Louisiana			Massachusetts			Ohio		
Year	**Total**	**per VMT***	**% Change**	**Total**	**per VMT***	**% Change**	**Total**	**per VMT***	**% Change**	**Total**	**per VMT***	**% Change**
2018	130267	447.2	-	30354	719.2	-	22433	417.3	-	49258	481.9	-
2019	126910	424.6	-5.1%	31556	725.7	0.9%	23075	399.3	-4.3%	51066	518.9	7.7%
2020	89239	365.9	-13.8%	25788	694.9	-4.2%	15256	343.0	-14.1%	42553	513.6	-1.0%

The similarities between California and Massachusetts extend into a monthly analysis. Both states experienced uniformly negative changes in injury collisions per VMT from March to October, though Massachusetts experienced greater reductions in April and May.

Louisiana and Ohio both had increases and decreases in monthly injury collisions per VMT. For both states, April had the greatest decrease and July had the greatest increase. Louisiana's decreases in the early months of the examined time span were larger.

Figure 3: Injury Collisions Change from 2019 to 2020 by Month



Fatal Collisions

Comparing the relationship between fatal collisions per VMT, Massachusetts had a significantly lower fatal collisions per 100 million vehicle-miles traveled than the other states. This statistic would remain lower than the other states in 2020, despite a substantial increase compared to the previous year.

Both Massachusetts and Ohio experienced a greater than 30% increase in fatal collisions per VMT from 2019 to 2020. Louisiana experienced a 22.2% increase, while California experienced a 10.5% increase. All states had increases in fatal collision per VMT from 2019 to 2020 from March to October. Only California experienced a decrease in total fatal collisions from 2019 to 2020 from March to October.

Table 4: Fatal Collisions per 100 Million VMT from March to October

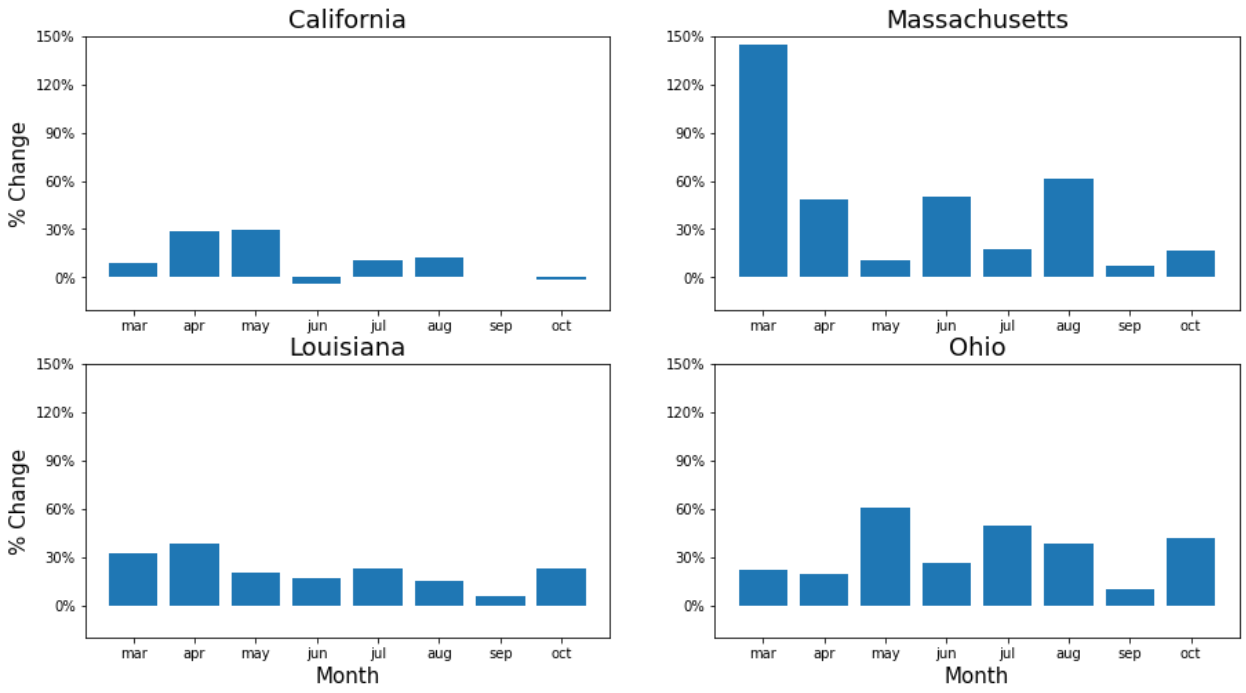
	California			**Louisiana**			**Massachusetts**			**Ohio**		
Year	**Total**	**per VMT***	**% Change**	**Total**	**per VMT***	**% Change**	**Total**	**per VMT***	**% Change**	**Total**	**per VMT***	**% Change**
2018	2290	7.9	-	470	11.1	-	221	4.1	-	732	7.1	-
2019	2282	7.6	-3.8%	510	11.7	5.4%	222	3.9	-4.9%	753	7.6	7.0%
2020	2035	8.4	10.5%	520	14.3	22.2%	229	5.4	38.5%	851	10.2	34.2%

All states experienced a general increase in fatal collisions per VMT across months. Unlike injury collisions per VMT, changes in fatal collisions per VMT were primarily of the same sign, with only California experiencing modest reductions in fatal collisions per VMT in June and October.

Both California and Louisiana had their most significant increases in fatal collisions per VMT at the start of the public health emergency. Massachusetts experienced a very significant increase in March, and would also have experience increases in April, June, and August. Interestingly, in Ohio, fatal collisions per VMT would slightly increase in April, when the greatest restrictions were put into place for the duration of one month, but would peak until May.

Traffic safety statistics like fatal collisions per VMT for Massachusetts in March occur because of the low likelihood of a fatal collision per mile driven. In Massachusetts, 15 fatal traffic collisions occurred in 2019 and 28 occurred in 2020, while VMT fell from 55 to 42 million miles. Therefore, the difference between fatal collisions per VMT was almost 150%. It is important to note that over the examined time period, Massachusetts would also have the lowest incident of fatal collision per VMT.

Figure 4: Fatal Collisions Change from 2019 to 2020 by Month



Discussion

Different traffic safety trends persisted in different states from March to October.

- Reductions in VMT from 2019 to 2020 was experienced across all states, with the most substantial reductions in April and May for all states.
- All states were found to have a decrease in reported collisions and injury collisions per VMT, although the reductions for California and Massachusetts were greater than the reductions for Louisiana and Ohio. Louisiana and Ohio had significant decreases at the start of the public health emergency and increases towards the end of the analyzed period when compared to 2019.
- All states were found to have increases in fatal collisions per VMT. Both Massachusetts and Ohio's fatal collision per VMT rose more than 30%. The largest increases for California, Louisiana, and Massachusetts occurred in the early months of the public health emergency, when VMT fell the most from 2019 levels. Only in Ohio did the total number of fatal collisions change significantly from 2019 to 2020, with 100 more fatal collisions occurring in Ohio in 2020 (a 13% increase).

Synthesizing the traffic safety trends and state-level restrictions, a few correlations are notable. Reported and injury collisions per VMT were lower in 2020 than 2019 in the early months of the pandemic, when states rolled out the strictest containment measures. The states with strict containment measures throughout the summer, California and Massachusetts, saw reductions in injury collisions per VMT every month observed. States with less strict containment measures had increases in injury collisions per VMT from 2019 to 2020 after the initial few months of the public health emergency. The most significant increases in fatal collisions per VMT occurred in

the months following the initial public health emergency for California, Louisiana, and Massachusetts.

The most significant increases in fatal collisions per VMT occurred in Massachusetts and Ohio. This similarity in trend occurred despite Massachusetts having a little more than half the fatal collisions per VMT of Ohio from 2018 to 2020. Massachusetts had significantly lower injury and fatal collisions per VMT than other states across the same time period, yet experienced similar changes to traffic safety. This points to a broader missed opportunity by states to respond to decreased demand for automobile infrastructure and prevent increases in fatal collisions per VMT. Although some states performed better than others, more effort is required by all states to manage vehicle speeds and alter automobile infrastructure to create safer and more resilient transportation systems.

Conclusion

The COVID-19 public health emergency had significant impacts on the traffic safety of road users in California, Louisiana, Massachusetts, and Ohio in 2020. For every vehicle-mile traveled, road users were less likely to be involved in a collision or injury collision, but more likely be involved in a fatal collision. These trends hold true for the states examined, despite significant differences in each states' traffic safety record.

Traffic safety in the span of March to October in 2020 changed markedly from the preceding year. Examining each state's traffic safety data at monthly intervals, it was found that reported collisions and injury collisions per VMT decreased from 2019 levels for all states, but only at the start of the public health emergency. Fatal collisions per VMT increased for all states nearly every month, but California and Louisiana's increases occurred mostly during the start of the public health emergency, while Massachusetts and Ohio had significant increases throughout the time span observed. Despite differences in pre-COVID traffic collision data, the pandemic's consistent effect on different traffic safety statistics across the states analyzed suggests states face similar traffic safety concerns, and that similar efforts to create Safer Systems are applicable.

Future Work

Further analysis of the COVID-19 public health emergency's effect on traffic safety could better determine the causes of changes in traffic safety during the pandemic, and could potentially better inform transportation engineers and planners of the effects of future sudden changes in commute behavior on traffic safety.

A more fine-grained analysis with VMT data at the level of census tracts or counties could reveal the environments and the kinds of infrastructure that saw the greatest changes in traffic safety statistics. One interesting area of observation is the potential changes to urban versus rural traffic safety. NHTSA observed significant increases in urban road speeds in 2020 but no significant changes to rural road speeds (Office of Behavioral Safety Research, 2021). Using finer VMT data, observations about changes in the two environment's traffic safety paradigms may produce important conclusions.

Including vehicle speeds in traffic safety analysis would be another promising approach. Increased vehicle speeds lead to less safe traffic safety conditions, as kinematic energy of vehicles increases quadratically with velocity. Identifying the areas in which vehicle speeds have increased during the pandemic could help explain changes in traffic safety conditions.

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Appendix

State Overview

Table 5: California Traffic Safety Statistics from March to October

	VMT (100 Millions)		All Collisions		Injury Collisions		Fatal Collisions	
Year	**Total**	**% Change**	**Total**	**% Change**	**Total**	**% Change**	**Total**	**% Change**
2018	2339	-	324757	-	130267	-	2290	-
2019	2400	2.6%	314908	-3.0%	126910	-2.6%	2282	-0.3%
2020	1950	-18.8%	228291	-27.5%	89239	-29.7%	2035	-10.8%

Table 6: Louisiana Traffic Safety Statistics from March to October

	VMT (100 Millions)		All Collisions		Injury Collisions		Fatal Collisions	
Year	**Total**	**% Change**	**Total**	**% Change**	**Total**	**% Change**	**Total**	**% Change**
2018	340	-	108534	-	30354	-	470	-
2019	350	2.8%	110002	1.4%	31556	4.0%	510	8.5%
2020	295	-15.6%	88084	-19.9%	25788	-18.3%	520	2.0%

Table 7: Massachusetts Traffic Safety Statistics from March to October

	VMT (100 Millions)		All Collisions		Injury Collisions		Fatal Collisions	
Year	**Total**	**% Change**	**Total**	**% Change**	**Total**	**% Change**	**Total**	**% Change**
2018	429	-	91168	-	22433	-	221	-
2019	461	7.4%	92160	1.1%	23075	2.9%	222	0.5%
2020	352	-23.7%	60133	-34.8%	15256	-33.9%	229	3.2%

Table 8: Ohio Traffic Safety Statistics from March to October

	VMT (100 Millions)		All Collisions		Injury Collisions		Fatal Collisions	
Year	**Total**	**% Change**	**Total**	**% Change**	**Total**	**% Change**	**Total**	**% Change**
2018	818	-	195038	-	49258	-	732	-
2019	787	-3.8%	195056	0.0%	51066	3.7%	753	2.9%
2020	654	-16.9%	152716	-21.7%	42553	-16.7%	851	13.0%