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Bicyclist Stop-as-Yield Law Analysis

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16. Abstract

In 1982 Idaho passed the first stop-as-yield (SAY) law for bicyclists, allowing bicyclists to treat stop signs as yield signs and (as of 2006) red lights as stop signs. Since then, 8 other State legislatures (Delaware, Arkansas, Oregon, Washington, Utah, North Dakota, Oklahoma, and Colorado) and Washington, DC have adopted similar laws. This research report presents the results of a systematic review and empirical analysis to examine SAY laws and their effects on bicyclist safety and behaviors. The study focused on 8 selected metropolitan statistical areas across different States. The analysis considered objective outcomes to explore the effects of SAY laws on bicycle conflicts, crashes, injuries, and fatalities. Additionally, the study investigated whether these laws influence bicycling volumes and assessed any changes in reckless bicycling behavior post-enactment. Results indicate that SAY laws were associated with reduced crash rates, with reductions most prominent at suburban stop-controlled intersections and urban signal-controlled intersections. The analysis found little evidence that SAY laws reduce injury severity or lead to more crashes involving children. Various socioeconomic and demographic factors were explored and did not appear to influence crash clusters. The findings also suggest that SAY laws do not significantly influence reckless bicycling behavior, but further examination of crash-contributory behavioral factors is warranted. These findings contribute to a nuanced understanding of SAY laws and their implications for promoting bicyclist safety and active transportation.

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Executive Summary

In 1982 Idaho passed the first stop-as-yield (SAY) law for bicyclists, allowing bicyclists to treat stop signs as yield signs and (as of 2006) red lights as stop signs. Since then, State legislatures in Delaware, Arkansas, Oregon, Washington, Utah, North Dakota, Oklahoma, and Colorado, plus Washington, DC, have adopted similar laws.

This research study explores the impact of SAY laws on bicyclist safety and behavior at intersections, contributing essential insights to the ongoing debate surrounding these controversial laws. A legislative review documented successful and failed efforts to enact such laws, while a literature review explored the contrasting perspectives and research into relevant maneuvers and behaviors. The research team conducted an empirical analysis across metropolitan statistical areas (MSA) in the 8 States, examining objective outcomes to assess the effects of SAY laws. The analysis used objective outcomes derived from crash records, mitigating the influence of anecdotal and other non-statistical information. Statistical models estimated monthly crash rates while accounting for bicyclist and motorist volumes, which were significantly impacted by the COVID-19 pandemic.

Results demonstrated that SAY laws were associated with reduced crash rates, particularly at suburban stop-controlled intersections and urban signal-controlled intersections. The investigation into bicyclist injuries and fatalities found little evidence that SAY laws reduce injury severity or lead to more crashes involving children.

The research team found no significant change in reckless behaviors following the enactment of SAY laws. This suggests that such laws do not foster a disregard for traffic regulations among bicyclists. Nevertheless, the analysis identified areas where further research into crash-contributory behavioral factors could provide additional clarity. SAY laws have the potential to positively influence bicycling volumes, with a potential increase in bicycling activity encouraged by the perceived ease of navigating intersections. The data collected by this study did not allow for a quantification of this relationship.

The research team also examined the influence of socioeconomic factors on crash patterns. The findings revealed that the built environment and urbanicity had a more significant impact on crash occurrence than socioeconomic factors, underlining the importance of infrastructure and urban planning in promoting bicycle safety. The research team observed a notable over-representation of Black/African American bicyclists in SAY-related crashes, indicating potential disparities in bicyclist safety outcomes that require further examination.

In conclusion, this research report offers a nuanced understanding of the effects of SAY laws on bicyclist safety and behavior at intersections. These laws were associated with reduced crash rates, especially at suburban stop-controlled intersections and urban signal-controlled intersections but were not associated with reduced injury severity. SAY-related crashes did not appear to be correlated with selected socioeconomic and demographic factors but did include an over-representation of Black/African American bicyclists. Further research into crash-contributory behavioral factors is warranted. The potential impact on bicyclist volumes also warrants further investigation. This research contributes valuable insights that can aid policymakers, urban planners, and traffic safety advocates in crafting evidence-based strategies to foster safer coexistence between bicyclists and motorists, promote active transportation, and enhance public health.

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Introduction

Stopping, as indicated by stop signs or red traffic signals, is an established requirement on roadways of all types. Yet, a recent study suggests that the rate of complete stops among drivers at all-way stop-controlled intersections may be as low as 20 percent (Liu & Zhang, 2022). Complete stops among bicyclists range from 2 percent (Caldwell et al., 2016) to 57 percent (Ayres et al., 2015) at stop signs and 30 percent (Caldwell et al., 2016) to 89 percent (Johnson et al., 2008) at red lights. Authors report that bicyclists often prioritize maintaining momentum and conserving energy over strict adherence to traffic laws, resulting in a low rate of complete stops. However, many bicyclists exhibit cautionary behavior and assess potential conflicts before crossing intersections, suggesting a rational approach to road usage despite violating intersection controls.

In 1982 Idaho passed the first stop-as-yield (SAY) law for bicyclists, colloquially known as the *Idaho Stop Law.* This law allows bicyclists to treat stop signs as yield signs and (as of 2006) red lights as stop signs. Since then, 8 other State legislatures (Delaware, Arkansas, Oregon, Washington, Utah, North Dakota, Oklahoma, and Colorado) plus Washington, DC, have adopted similar laws.

This research aims to conduct a review and empirical analysis of outcomes related to State stop-as-yield laws. Specific research questions are listed below.

1. How do SAY laws affect motor-vehicle-bicycle conflicts and crashes?
2. How do SAY laws affect bicyclist injuries and fatalities?
3. Do SAY laws promote or decrease reckless bicycling behavior?
4. How do SAY laws affect bicycling volumes?

The following sections provide findings from the legislative and literature review, describe the methodology of the empirical analysis, and discuss the results.

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Legislative Review

Carl Bianchi was the original champion of the *Idaho Stop Law*. Bianchi was an avid bicyclist working in the Idaho legislature. At the time, Idaho courts were responsible for processing traffic violations for bicyclists who failed to come to complete stops at stop signs. Bianchi and his colleagues viewed these "technical violations" as unnecessary burdens on the legal system and sought to attach a bill to the traffic code, which was in the process of being revised (Bernardi, 2009). The revised traffic code and attached bill were approved in 1982, permitting rolling stops at stop signs after yielding the right-of-way to other road users, right-hand turns at red lights, and left-hand turns onto one-way roads at red lights. Language was added in 2005 to explicitly allow bicyclists to proceed straight at red lights after stopping. The current full text of the *Idaho Stop Law* (Idaho Code Ann. § 49-720) is shown in Figure 1.

49-720. STOPPING -- TURN AND STOP SIGNALS.

(1) A person operating a bicycle, human-powered vehicle, or an electric-assisted bicycle approaching a stop sign shall slow down and, if required for safety, stop before entering the intersection. After slowing to a reasonable speed or stopping, the person shall yield the right-of-way to any vehicle in the intersection or approaching on another highway so closely as to constitute an immediate hazard during the time the person is moving across or within the intersection or junction of highways, except that a person, after slowing to a reasonable speed and yielding the right-of-way, if required, may cautiously make a turn or proceed through the intersection without stopping.

(2) A person operating a bicycle or human-powered vehicle approaching a steady red traffic control light shall stop before entering the intersection and shall yield to all other traffic. Once the person has yielded, he may proceed through the steady red light with caution. Provided however, that a person, after slowing to a reasonable speed and yielding the right-of-way, if required, may cautiously make a right-hand turn. A left-hand turn onto a one-way highway may be made at a red light after stopping and yielding to other traffic.

(3) A person riding a bicycle shall comply with the provisions of section 49-644, Idaho Code.

(4) A signal of intention to turn right or left shall be given during not less than the last one hundred (100) feet traveled by the bicycle before turning, provided that a signal by hand and arm need not be given if the hand is needed in the control or operation of the bicycle.

Figure 1. Current full text of the Idaho Stop Law

For several decades Idaho remained the only State with legal rolling stops for bicyclists. Table 1 summarizes subsequent States that have introduced and enacted SAY laws. Notable attributes include age limitations, roadway restrictions, and other deviations from the Idaho model. Dispositions include:

- died in process (failed to finalize a bill to introduce),
- introduced (the bill was presented to a legislative body but never voted upon),
- failed (the bill was voted on but not passed by either the State's Senate or House of Representatives),
- engrossed (one legislative body voted to adopt the bill),
- enrolled (both legislative bodies voted to adopt),
- vetoed (adopted by both bodies but stricken down by the Governor), and
- passed (signed into law).

Many States and jurisdictions began introducing SAY bills in the 2000s, but the bills would ultimately fail for various reasons. Some States like Arkansas initially failed to pass the bills but were later successful. While many failed bills were introduced at the State level, some local ordinances were introduced and failed. In 2017 Delaware became the next State after Idaho to enact a SAY law. Arkansas was next in 2019, with Oregon and Washington following suit in 2020, North Dakota, Oklahoma, and Utah in 2021, and Colorado and Washington, DC, in 2022. Of the 10 States (including DC) with SAY laws, 4 allow bicyclists to treat red lights as stop signs.

Table 1. Statewide Stop-as-Yield bills

State	Legislative Session Years	Bill Number	Notable Attributes	Red Light Provision	Sponsors	Political Affiliation of Sponsor(s)	Disposition
Arkansas	2019	SB388[1]	None	Yes	1	Partisan (R)	Passed
Colorado	2018	SB144[2]	It suggests standard language for municipalities to adopt but does not implement it. Defines a reasonable speed as $\leq$ 15 mph	Yes	3	Bipartisan	Passed
Colorado	2022	HB1028[3]	Age minimum: 15 Redefines reasonable speed as $\leq$ 10mph.	Yes	30	Bipartisan	Passed
Delaware	2017	HB185[4]	Restricts to roadways with two or fewer lanes.	No	13	Bipartisan	Passed
North Dakota	2021	HB1252[5]	Limited to roadways with two or fewer lanes. Requires bicyclists who encounter stopped vehicles to perform a complete stop. States that any collision that transpires after the bicyclist passes a stop sign without stopping is evidence of their failure to yield the right-of-way.	No	9	Bipartisan	Passed
Oklahoma	2016	HB2999[6]	None	Yes	2	Partisan (R)	Introduced
Oklahoma	2021	HB1770[7]	It makes it unlawful to throw objects at bicyclists maliciously	Yes	5	Bipartisan	Passed

[1] S.B. 388, 92d Gen. Assemb., Reg. Sess. (Ark. 2019).
[2] S.B. 144, 2018 Reg. Sess. (Colo. 2018).
[3] H.B. 1028, 2022 Reg. Sess. (Colo. 2022).
[4] H.B. 185, 149th Gen. Assemb. (Del. 2017).
[5] H.B. 1252, 67th Leg. Assemb. (N.D. 2021).
[6] H.B. 2999, 2016 Reg. Sess. (Okla. 2016).
[7] H.B. 1770, 2021 Reg. Sess. (Okla. 2021).

State	Legislative Session Years	Bill Number	Notable Attributes	Red Light Provision	Sponsors	Political Affiliation of Sponsor(s)	Disposition
Oregon	2003	HB2768[8]	Increases fine from $75 to $300. Mentions flashing red lights (equivalent to stop signs).	No	1	Partisan (D)	Engrossed
Oregon	2019	SB998[9]	Reduces traffic violations from Class B to Class D. Mentions flashing red lights (equivalent to stop signs).	No	1	Other	Passed
Utah	2010	HB91[10]	The red light provision was removed via amendment after introduction.	No	2	Bipartisan	Engrossed
Utah	2011	HB155[11]	Age minimum: 18	No	2	Bipartisan	Introduced
Utah	2018	HB58[12]	Removes the age restriction. Does not apply to intersections with active railroad grade crossings. Restricts red light provision to roadways with one travel lane in each direction.	Yes	2	Bipartisan	Engrossed
Utah	2019	HB161[13]	Restricts red light provision to roadways with speed limits at or below 35 mph.	Yes	2	Bipartisan	Engrossed
Utah	2021	HB142[14]	Retains the exclusion for intersections with active railroad grade crossings. Drops the exclusion for roadways with more than one travel lane in each direction. Drops the red light provision.	No	2	Bipartisan	Passed

[8] H.B. 2768, 2003 Reg. Sess. (Or. 2003).
[9] S.B. 998, 2019 Leg. Measures (Or. 2019).
[10] H.B. 91, 2010 Reg. Sess. (Utah 2010).
[11] H.B. 155, 2011 Gen. Sess. (Utah 2011).
[12] H.B. 58, 2018 Gen. Sess. (Utah 2018).
[13] H.B. 161, 2019 Gen. Sess. (Utah 2019).
[14] H.B. 142, 2021 Gen. Sess. (Utah 2021).

State	Legislative Session Years	Bill Number	Notable Attributes	Red Light Provision	Sponsors	Political Affiliation of Sponsor(s)	Disposition
Washington, DC	2016	B21-0335[15]	SAY provision was removed prior to passage. What did pass: providing open access to data and information, developing a bicycle and pedestrian priority area program, developing a Complete Streets policy, providing bicycle consumer protections, and requiring safety education for children in public schools.	No	1	Partisan (D)	Passed
Washington, DC	2022	B24-0673[16]	It also allows bicyclists to heed pedestrian signals	Yes	5	Partisan (D)	Passed

[15] B21-0335, 21st Council (D.C. 2016).
[16] B24-0673, 24th Council (D.C. 2023).

The path to implementing SAY laws varied considerably by jurisdiction. Efforts that led to the enactment of laws since Idaho are described alphabetically below.

Arkansas approved a SAY bill in 2019, which included a red-light provision. The 2019 bill was touted as one that "made [Arkansas] roads safer for bicyclists, improved traffic flow, and boost[ed] tourism." (Schmitt, 2019). The director of State and local policy for the advocacy group People For Bikes claimed that studies showed bicyclists are "safer when they are able to get a head start at intersections, and they become more visible to the drivers behind them." (*Arkansas Democrat-Gazette*, 2019). The director of the League of American Bicyclists added that the law would "improve the safety of bicyclists by promoting the use of side streets and lessening the time that bicyclists are exposed to dangers at intersections" (KARK, 2019). At the 2020 National Bike Summit, the Governor's Advisory Council on Cycling chair partially credited the bill's success to keeping the efforts confined to the "halls of the legislature" (McLeod et al., 2020).

Colorado has a unique history with SAY, as various municipalities have adopted it, with and without the two State laws. The town of Dillon (population 1,064 in 2020) was first in 2011 (Corazzelli, 2011), followed shortly by Breckenridge, which added a red-light provision. The following year, the county of Summit (which encompasses Dillon) passed a similar measure. Aspen then adopted the SAY in 2014. Unlike any other SAY bill or ordinance, Aspen's rule only applied to bicyclists older than 10 and excluded county roads (Salvail, 2014).

A statewide bill in 2018 was sponsored by members of both political parties but did not legalize the maneuver at the State level. Instead, it allowed municipalities to do so with a local ordinance or resolution, paving the way for the passage of measures in the municipalities of Thornton, Berthoud, and Englewood. A statewide SAY law was enacted in 2022. The bill had bipartisan support from 30 sponsors. It also imposed an age minimum of 15 years and defined a reasonable speed as less than 10 mph, whereas most other laws use 15 mph.

Delaware became the next State to pass a statewide SAY law after Idaho in 2017. The law did not include a red-light provision and was restricted to roadways only with one or two lanes. It also made aggressive honking illegal and added a 3-foot passing requirement. The advocacy group Bike Delaware is credited for its passage. (Wilborn, 2018). In a National Bike Summit panel discussion, the group stressed the importance of getting the State Police involved in advocacy efforts and targeting messaging to various stakeholders (McLeod et al., 2020).

North Dakota passed three bicyclist laws in 2021: SAY, including the red-light provision, a 3-feet safe passing law, and the re-classification of some e-bikes as bicycles (previously called "motorized vehicles") (Valley News Live, 2021). A sponsor of all three bills said the new laws were part of a broader effort to educate bicyclists and drivers on road safety to encourage "less tension between motorists and bikers" (Jahfetson & Willis, 2021). The House Transportation Committee expressed concerns about the bill being perceived as "special legislation" that allows bicyclists to "break roadway rules" (Kristan, 2021a). The executive director of the North Dakota Active Transportation Alliance referred to the law as the "codification of a commonsense activity." He credited its passage to municipalities' efforts to develop pro-bicycling roadways (Kristan, 2021b).

Oklahoma enacted a SAY law with a red-light provision in 2021. Arguments for the law – which also forbids motorists from honking at bicyclists in the absence of imminent danger – appealed to the safety argument (Ellis, 2021). One sponsor for the bill stated that it would "improve safety for our bicyclists who share the road with motorists and pedestrians, clarifying the responsibilities for each traveler" (Querry-Thompson, 2021). The Indian Nations Council of Governments and the Metropolitan Planning Organization for the Tulsa Region collaborated with lawmakers to spearhead the effort. Bicycling advocates were also credited for its passage. (*News on 6*, 2021).

Oregon was the first State to consider a SAY bill outside of Idaho (in 2003), but it did not adopt it until 2019. Due to persistent efforts at passing legislation over several years, a favorable environment for consideration in the Oregon State House, and encouragement from the recent successes in Delaware and Arkansas, the law was passed in 2019 and put into effect in 2020 (Thomas, 2019). The law does not include a red-light provision and reduces the traffic violation associated with bicyclists' improper entry into intersections from a Class B traffic violation to Class D.

Utah lawmakers passed a SAY bill in 2021 after several previous efforts. The bill passed with little debate or resistance (*Senate Hearing, 2021 Utah State Legislature*, 2021). Compared to previous bills, the 2021 bill did not include a red-light provision, retained an exclusion for stop-controlled intersections with active rail crossings, and eliminated an exclusion for roadways with more than one travel lane in each direction. The bill's primary sponsor attributed its passage to removing the red-light provision (Meiners, 2021).

Washington, DC City Council passed the *Safer Streets Amendment Act* in 2022 (to go into effect in 2024), which included a SAY provision permitting rolling stops at stop signs and traffic signals. Public hearings indicated support for the measure from residents and advocacy groups such as the Washington Area Bicyclist Association (Council of the District of Columbia, 2022). The DC DOT, however, expressed concerns for safety, stating that the district's higher traffic volumes and prominence of complex intersections are incongruent with the law and that endorsing such a policy could encourage dangerous behaviors (Council of the District of Columbia, 2022). Notably, the Act also bans drivers from turning right on red, potentially eliminating a common crash type for urban bicyclists (Lord, 2002).

Legislative review of the various States that failed to pass "Stop-as-Yield" (SAY) laws were due to factors that included the following.

1. **Safety Concerns:** One of the main arguments against SAY laws is the safety concern. Opponents argue that allowing bicyclists to treat stop signs as yield signs could increase the risk of accidents and send mixed safety messages to children and drivers.
2. **Perceived Entitlement:** There is a worry that such laws could foster a sense of entitlement among bicyclists, leading to reckless behavior and a potential increase in fatalities.
3. **Legislative Stalemates**: Many bills have stalled in committees, failing to gain the necessary support for progression due to opposition from influential groups.
4. **Gubernatorial Vetoes**: Even when SAY legislation passes through State legislatures, governors might veto it because they fear the laws would have the opposite effect of their intended goal of enhancing safety.
5. **Lack of Community Support**: In some States, proposed SAY laws have failed due to insufficient backing from the bicycling community or missed legislative deadlines.
6. **Economic Concerns**: Some worry about the financial impact of implementing such laws, including the cost of installing new signage and modifying existing traffic systems.

In summary, the passage of SAY bills depended on a combination of factors including safety concerns, public perception, support from advocacy groups, education efforts, tailoring to specific contexts, and bipartisan support. Efforts resulting in passage often had strong support from bicycle advocacy groups who involved educating stakeholders including law enforcement and the public, about the benefits and safety aspects of the SAY law. Advocacy efforts in some States were credited for successfully passing SAY bills. States that successfully passed SAY bills often considered specific local factors and tailored the legislation accordingly. For example, in Colorado different municipalities adopted SAY ordinances with unique provisions based on their needs and concerns. Some SAY bills faced opposition due to specific provisions, such as allowing bicyclists to treat red lights as stop signs. States that passed SAY bills often saw bipartisan support, indicating that the issue was not purely along party lines. Additionally, compromise and adjustments to the bill's content played roles in passage.

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Literature Review

For this literature review, each section below examines one facet of SAY and how it is viewed positively and negatively, followed by a discussion of relevant findings in the scientific literature.

The scope of this review is limited to SAY laws, associated maneuvers, and effects on bicyclist behaviors, safety, and volumes. Few sources identified in this review directly analyzed the effects of SAY laws. Accordingly, the scope was expanded to include work that studied bicyclist compliance at stop signs and traffic signals generally—factors correlated with the decision to choose bicycling as a mode of transportation—and encounters with law enforcement.

States such as Arizona, Illinois, Indiana, Kansas, Minnesota, Missouri, Nevada, South Carolina, Tennessee, Virginia, and Wisconsin have no SAY laws but do have *"Dead Red"* laws that allow bicyclists to proceed through inoperative and malfunctioning traffic signals after either a specified or "reasonable" period (League of American Bicyclists, n.d., 2021). Although these laws govern similar behavior, they were considered outside the scope of this review.

Bicyclist Stopping Behaviors at Stop Signs and Red Lights

It is frequently claimed when discussing SAY that bicyclists do not stop at stop signs and red lights. Proponents and opponents both cite this behavior to justify their positions on SAY. Those in favor of the law claim it is "common sense" and should be adopted to reflect this reality (Darrow, 2021; Roche, 2018). One source went as far as to designate SAY laws as a "subsidy" that removes "stigma and shame" for bicyclists who engage in this common practice (Tekle, 2017). Those who oppose SAY laws question the need to regulate the behavior (Chacon, 2016).

Cyclists hold different definitions of what constitutes a stop. One lifelong bicyclist indicated that he "always" stopped at stop-controlled intersections but classified his behavior of "often slow[ing] VERY perceptibly, almost to a full stop, before entering the intersection" as a "stop." (Takemoto-Weerts, 2010). Research has confirmed that many bicyclists engage in similar behavior. One study observed 112 bicyclists at a stop-controlled intersection on a college campus, yielding a non-compliance rate of 96 percent (Lavetti & McComb, 2014). This study only considered complete stops to be compliant and did not differentiate between behaviors with and without cross-traffic. Kircher et al. (2018) also omitted information on cross-traffic, finding that 16 percent of observed bicyclists in Sweden passed through a stop-controlled intersection with little or no speed reduction, 43 percent displayed a distinct speed reduction, and 41 percent came to a complete stop. Yet, when Australia's Safer Cycling Study directly asked participants which rules of the road they had ever broken, just 5 percent admitted to treating a stop sign as a yield sign, while 38 percent admitted to "going through" a red light and 6 percent admitted to departing early from a red light (Shaw et al., 2014). Such research demonstrates that riders may have a different definition of "stopping" than completing a full stop. Others have documented bicyclist compliance at stop- and signal-controlled intersections with wide-ranging results.

Table 3 summarizes the findings identified in this review regarding compliance with stop signs and red lights.

Table 2. Summary of findings regarding bicyclist compliance at stop signs (in order of publication year)

Source	**Country**	**Sample Size**	**Methodology**	**Cross-Traffic**	**Findings**
(Shaw et al., 2014)	Australia	770 transport bicyclists	Online Survey	Not specified	5% have treated a stop sign as a give way sign
(Lavetti & McComb, 2014)	U.S. (West Lafayette, Indiana)	112 bicyclists observed	Field observation	Not specified	4% complete stop
(Ayres et al., 2015)	U.S. (Berkeley, California)	73 bicyclists	Field observation	With	57% complete stop 43% slowed 0% full speed
				Without	3% complete stop 81% slowed 16% full speed
(Caldwell et al., 2016)	U.S. (Chicago, Illinois)	Unspecified subset of 875 bicyclists	Field observation	With	9% complete stop 66% slowed 25% full speed
				Without	2% complete stop 43% slowed 55% full speed
(Kircher et al., 2018)	Sweden	41 local bicyclists	Planned route, instrumented bicycle	Not specified	41% complete stop 43% slowed 16% full speed
(Chaloux & El-Geneidy, 2019)	Canada (Montreal)	1,329 bicyclists	Online survey	Not specified (at four-way stop)	9% complete stop 99% slow 3% slow *without looking* 1% full speed

Table 3. Compliance at signal-controlled intersections

Source	Country	Sample Size	Methodology	Cross-Traffic	Findings
(Allen et al., 2005)	England	927 bicyclists (control sites only)	Field observation	Not specified	55% compliant
(Johnson et al., 2008)	Australia	876 bicyclists	Field observation	Not specified	3% accelerated toward amber 5% did not stop 4% rolling stop, proceeded before green 89% complete stop, waited until green
(Loskorn et al., 2010)	U.S. (Austin, Texas)	64 bicyclists	Field observation	Not specified	94% compliant
(Johnson et al., 2011)	Australia	4,225 bicyclists	Field observation	With	96% compliant
				Without	51% compliant
(Johnson et al., 2013)	Australia	2,061 bicyclists	Online Survey	Not specified	63% compliant
(Shaw et al., 2014)	Australia	770 transport bicyclists	Online Survey	Not specified	38% have gone through a red light 6% proceeded before green
(Pai & Jou, 2014)	Taiwan	12,447 bicyclists	Field observation	Not specified	7% did not stop (may have slowed down) 9% waited, proceeded before green 84% complete stop, waited until green
(Caldwell et al., 2016)	U.S. (Chicago, Illinois)	Unspecified subset of 875 bicyclists	Field observation	With	5% did not stop 17% rolling stop, proceeded before green 78% complete stop, waited until green
				Without	5% did not stop 65% rolling stop, proceeded before green 30% complete stop, waited until green
(Fraboni et al., 2016)	Italy	1381 bicyclists	Field observation	Not specified	33% did not stop 30% rolling stop, proceeded before green 37% complete stop, waited until green
(Kircher et al., 2018)	Sweden (Linköping)	41 local bicyclists	Planned route, instrumented bicycle	Not specified	5% did not stop
(Twaddle & Busch, 2019)	Germany (Munich)	4,710 bicyclists	Field observation	Not specified	20% violated red signal

Others have documented various degrees of stopping among bicyclists and give findings differentiated by the presence or absence of cross-traffic. Ayres et al. (2015) showed that complete stops happen rarely in the absence of cross-traffic (3% of crossings), and rolling stops are common with cross-traffic (43%) and even more common without (81%), noting that "most of the bicyclists exhibited cautionary behavior, slowing to some extent and turning to look for potential conflicts before crossing, soon enough to have allowed avoidance braking" (p. 1,619). Another field observation study in an urban university setting observed different behaviors: full stops were rare overall (9% with cross-traffic, 2% without), roughly half of all bicyclists slowed to some degree, and full-speed intersection crossings were common, even with cross-traffic (Caldwell et al., 2016).

An online survey asked Canadian bicyclists how they would proceed through a four-way stop-controlled urban intersection (Chaloux & El-Geneidy, 2019). Researchers found that just 9 percent of participants stated they would come to a complete stop; most (88%) would slow but not stop and check for cross-traffic before proceeding. Notably, 3 percent of respondents would slow down and proceed through the intersection *without checking for cross-traffic,* and 1 percent would proceed at full speed. Perhaps participants wrongly felt that the four-way stop configuration made these safe options.

The studies above all observed some degree of bicyclists proceeding through intersections at full speed. Researchers also point out in studies the argument that this behavior illustrates a potential risk associated with a SAY law: Bicyclists could interpret the law as permission to "proceed through intersections without adequate caution" (Bergal, 2018; Flowers, n.d.; Laurence, 2020; Maus, 2009a). Doing so could easily lead to a fatal crash, especially when cross-streets are not stop-controlled and have higher speed limits.

Cyclist compliance with red lights appears higher than with stop signs. Here, full compliance entails stopping and remaining so until the signal turns green. Studies varied in the level of detail shown regarding cross-traffic and degrees of compliance (i.e., compliant, non-compliant, did not stop, stopped but proceeded before green, stopped until green).

Disregarding the potential effects of cross-traffic, researchers have documented bicyclist compliance rates of 55 percent (Allen et al., 2005), 94 percent (Loskorn et al., 2010), 63 percent (Johnson et al., 2013), 95 percent (Kircher et al., 2018), and 80 percent (Twaddle & Busch, 2019). Several field observation studies distinguished between full and partial compliance, with one reporting that 5 percent of Australian bicyclists proceeded through intersections without stopping, 4 percent stopped but proceeded before the green, and 89 percent fully complied with the red signal (Johnson et al., 2008). In Taiwan 7 percent of bicyclists proceeded without stopping (but may have slowed), 9 percent stopped and proceeded before green (allowed under some implementations of the SAY law), and 84 percent were fully compliant (Pai & Jou, 2014). Bicyclists in Italy were more evenly distributed: 33 percent did not stop, 30 percent proceeded before green, and 37 percent were fully compliant (Fraboni et al., 2016). These studies suggest that bicyclist compliance at red lights is high but can vary for several reasons, including cultural differences, local bicycling norms, and other infrastructure, such as bike boxes.

When considered and analyzed, cross-traffic presence emerges as an important factor regarding bicyclist compliance at red lights. Compliance among Australian bicyclists was 51 percent without cross-traffic and 96 percent with cross-traffic (Johnson et al., 2011). In Chicago bicyclists were more compliant in the presence of cross-traffic: rolling stops and proceeding before green became less common (65% without, 17% with), and completely compliant stops became more common (30% without, 78% with) (Caldwell et al., 2016).

Cyclists have expressed several reasons motivating their actions. Australian bicyclists indicated that, among other reasons, they generally broke rules of the road because they felt the road was unsafe (27% of respondents), they were trying to avoid frustrating drivers (21%), to save time (17%), or to conserve momentum (7%) (Shaw et al., 2014). A convenience sample of bicyclists indicated the basis for observed behavior is that "they simply do not agree with the rules or they disregard them" (Lavetti & McComb, 2014). Canadian bicyclists cited the desire to save energy as the primary reason for not coming to a complete stop at a hypothetical four-way stop-controlled intersection (Chaloux & El-Geneidy, 2019). Specific to red-light-running, bicyclists in Australia indicated that they had disobeyed red lights because they were turning left (32%), believed the inductive detector loop failed to detect them (24%), or determined that there was no cross-traffic or pedestrian present (17%) (Johnson et al., 2013).

Bicyclist Safety

Many States and municipalities prioritize safety when considering SAY laws. Studies have examined various net safety impacts associated with SAY laws.

One potential safety claim is that SAY laws reduce the time for bicyclists to regain speed after a stop (Darrow, 2021; Roche, 2018; Stewart, 2017). Another claim is that SAY laws reduce the time spent stopped at intersections, noting that “bike riders are most exposed to being struck at intersections while at a full stop” (Luz, 2021). However, the lack of specific safety data for such claims has made some jurisdictions hesitant to adopt such laws.

SAY laws create different rules for bicyclists and drivers with the lack of uniformity and consistency undermining the *same roads, same rules* concept (League of American Bicyclists, n.d., 2013). Some argue that these laws do not meet the goals of predictability (Luz, 2021; Takemoto-Weerts, 2010). This approach may also impact children who legally cycle on roadways as they might mimic adults yielding at stop signs and make unsafe decisions (Darrow, 2021; Maus, 2009b; Stewart, 2017; Takemoto-Weerts, 2010). California’s governor vetoed the law in 2021 due to concerns for children “who may not know how to judge vehicle speeds or exercise the necessary caution to yield to traffic when appropriate” (BRAIN Staff, 2021).

Meggs (2008) conducted a study to examine the safety impacts of SAY laws by comparing the rate of injuries between Boise, Idaho, and the California cities of Sacramento and Bakersfield. The study calculated the rates of injuries per bicycle commuter using crash records from each State and data from the American Community Survey. The findings showed that Boise had a lower injury-per-commuter ratio than the other two cities, suggesting that the SAY law positively impacted safety. However, the study did not adequately explain its methodology and displayed mathematical inconsistencies across various tables. Additionally, it highlighted several limitations, the most notable being the large proportion (25%) of injuries among California bicyclists 15 and younger. It is unclear whether the number of bicycling injuries used in the ratio was adjusted for this age group. If not adjusted, reducing the injury count by 25 percent would result in a lower injury-per-commuter ratio for Sacramento compared to Boise. Moreover, the analysis did not account for relevant exposure metrics such as the time or distance traveled and the number of intersections (Reynolds et al., NHTSA, 2022).

Meggs (2010) described additional attempts to quantify the safety impact. These efforts included "interviews in Idaho . . . conducted with authorities including police, legislators, transportation professionals, bicycle leaders of both recreational and advocacy groups, people involved with the original adoption of the law, and members of the general public." The number and nature of these interviews is not described, although it is stated that, "these inquiries strongly supported adoption of the Idaho Law, and no entity whatsoever identified any negative safety result associated with passage of the law." Meggs also used the *State of Idaho Highway Safety Plan, Fiscal Years 1981-1984* to examine bicyclist injuries in Idaho before and after the law was passed (in 1982), finding that, "in the year following its introduction, bicycle injury rates in the State…declined by…14.5 percent." The information, however, does not make clear how the injury rates were calculated (including for the second year of the study). Further, the study specifies that "aggregate injury rates include numerous types of collisions," but does not provide clear support for the conclusion that "the decline in injuries is consistent with the strong indication that the law actually improves overall roadway safety." There is a general reference to video footage and intercept surveys that may have supported the statement, but this information is not shown.

Other studies do not provide specific support for aspects of SAY, such as reducing stops increases cycling. Dill (2009), for example, indicated that "reducing wait time due to stop signs/lights" earned a mean score of 2.67 on a scale from 1 (not at all important) to 5 (very important) from bicyclists in Portland, Oregon; minimizing total distance earned a mean score of 3.60, the highest of seven factors considered. Similarly, other studies such as Leth et al. (2014) merely summarized other research on bicycle safety and did not provide separate results demonstrating the safety benefits of the law.

Whyte (2013) focused on crash severity, comparing police-reported crashes from 2007 to 2011 in Boise, Idaho, to the Champaign-Urbana (Illinois) metropolitan area. These sites were selected based on similar land areas, population densities, bicycle mode share, and *road networks*: both used grid-based systems rather than cul-de-sacs. The analysis compared the proportions of crashes at each severity level between the two cities and in each city between intersection types (stop- or signal-controlled), finding essentially no (relevant) statistically significant differences.[17]

Whyte (2013) identifies the following three key limitations in his study. First, contributing causes recorded by the reporting officer were omitted, making it impossible to distinguish crashes involving a failure to yield (relevant to the SAY maneuver) from others. Second, the analysis relies solely on z-tests for differences in proportions, whereas a statistical model could account for more complex relationships with the other variables collected (road conditions, weather, time of day, and day of the week). Finally, the age of the injured bicyclist was not considered. This is less crucial for general injury counts but an important detail when analyzing crash severity, as the same crash events can produce more severe injuries in older bicyclists (Bahrololoom et al., 2020).

Delaware enacted a SAY law in 2017 (affecting stop-controlled intersections only). Bike Delaware published an analysis of the law (2021). The analysis compared crashes in the 30

[17] One statistically significant difference ($p < 0.05$) was found between "visible" and "possible" injuries at signal-controlled intersections (Whyte, 2013). This study found bicyclist crash severity distributions of 60 percent (visible) and 21 percent (possible) in the city without the SAY law, compared to 44 percent (visible) and 41 percent (possible) in the city with the SAY law. Thus, the no-SAY city experienced more visible crashes and fewer possible crashes than the SAY city.

months immediately before and after the law's enactment in October 2017. Bicyclist crashes at stop-controlled intersections fell by 23 percent, while all other bicyclist crashes fell by only 8 percent over the same period.

Law Enforcement

In States that prohibit the stop-as-yield, police officers can ticket bicyclists. Police officers have been reported staking out and ticketing bicyclists for performing rolling stops in Canada (Casaletto, 2022) and New York (Del Signore, 2011). Ridership and court data in New York City show that the number of tickets issued to bicyclists of color is disproportionately high, suggesting bias in the enforcement of bicycle laws (Cuba, 2022).

Proponents argue that adopting SAY laws could remove the possibility of bias in enforcement among marginalized communities (Weiss, 2022; Welsh, 2021). The organization known as CalBike (California Bicycle Coalition) has a web site at https://www.calbike.org/bicycle-safety-stop-law/ that has home page titled "Make the Bicycle Safety Stop Legal." Some examples include the following: Dave Snyder, a pro-bike lobbyist and advocate with CalBike in Sacramento, claimed that the law would give police "less of an opportunity to harass cyclists" (Welsh, 2021); and a lawyer testified during the 2018 Colorado Senate Committee hearings (that ultimately resulted in a law allowing cities to enact their own SAY laws) of a prior client that "explained that he, as a black man riding an expensive road bicycle, was emotionally devastated after he was pulled over by the police who claimed he failed to come to a complete stop at a stop sign and the police accused him of stealing the bicycle that he was riding" (Weiss, 2022).

Twenty-nine-year bicycle program coordinator of the University of California at Davis, David Takemoto-Weerts (2010), acknowledged that "some cyclists have been stopped and cited by police for not putting a foot down to the pavement at a stop sign, but those rare instances are the actions of abusive or ignorant officers and I don't believe they are such common occurrences to warrant a 'solution' like the Idaho law." In San Francisco, where a city ordinance failed to pass in 2015, Supervisor John Avalos pointed out that "common-sense enforcement of the law would make our streets safer and more predictable" (Goebel, 2015).

SAY law proponents claim that formally allowing rolling stops would remove any uneven enforcement (Stewart, 2017). Compared to the Netherlands, Denmark, and Germany, pedestrian and bicyclist traffic laws in the United States are less strictly enforced and less likely to result in a ticket (Pucher & Buehler, 2008). This has been proposed as a potential reason for widespread violations at stop signs and signals (Ayres et al., 2015).

When citations are issued, resources in the justice system must be devoted to processing them. This may include police officers, judges, and other people appearing in court, as well as related record-keeping and administrative tasks. SAY law proponents claim that legalizing rolling stops would reduce this burden and allow communities to allocate resources better (Barnes, 2016; Bernardi, 2019; Caldwell et al., 2016; Goebel, 2015; Thomas, 2019).

This review did not identify any evidence indicating that enforcement reduces the incidence of rolling stops or related crashes.

Awareness and Comprehension

Expectations are formed based on road user awareness and comprehension of applicable laws and observing one another in shared spaces. It is unclear how bicyclist and driver behaviors would be affected by SAY laws. If bicyclists are unaware of a SAY provision, they may perform complete stops at stop signs and red lights (or not, as described in Bicyclist Stopping Behaviors at Stop Signs and Red Lights section above). Bicyclists who are aware, however, may exercise their right during an encounter with an unaware driver. Non-cyclist drivers are less likely to become aware of the law (Hurwitz et al., 2023) and would continue to expect cyclists to either come to a complete stop (as the law may require) or perform a rolling stop (if the driver has observed that behavior in the past). When expectations become misaligned, conflicts or crashes can occur. A member of the Missing Link Bicycle Cooperative in Berkeley claims that there "could be situations where bikers are intending to just run a stop sign, and cars aren't ready for it – and that could lead to some dicey situations" (Darrow, 2021).

Concerns over SAY laws include that they create more confusion during interactions (Darrow, 2021; Associated Press, 2013), run counter to the principles of vehicular bicycling (Takemoto-Weerts, 2010), and violate the *same roads, same rules* concept (League of American Bicyclists, n.d., 2013). Supporters believe different treatment for vehicles and bicycles is a beneficial distinction (Tekle, 2017).

Hurwitz et al. (2023) probed residents of Idaho, Oregon, and Washington for familiarity with SAY laws (note that Oregon and Washington enacted SAY laws in 2020). Table 4 summarizes the results. Overall, bicyclists and non-bicyclists were largely unaware of the law (45.8% and 65.8%), and unsure of its meaning (24.6% and 17.8%).

Table 4. Familiarity with SAY laws, by State and road user group

State	Road User Group (N)	Yes (%)	No (%)	Familiar but Unsure of Meaning (%)
Idaho	Bicyclists (86)	43.0	33.7	23.3
	Non-bicyclists (69)	22.5	56.3	21.1
Oregon	Bicyclists (120)	25.8	50.8	23.3
	Non-bicyclists (78)	21.8	67.9	10.3
Washington	Bicyclists (119)	23.5	49.6	26.9
	Non-bicyclists (76)	5.3	72.4	22.4
Overall	Bicyclists (325)	29.5	45.8	24.6
	Non-bicyclists (223)	16.4	65.8	17.8

Source: (Hurwitz et al., 2023)

Operational Efficiency

SAY law supporters maintain that rolling stops conserve energy and maintain momentum (Furfaro, 2015; Watanabe, 2020). Some bicyclists admit that they already engage in the behavior of rolling stops even without a law in place (Bernardi, 2019; Caldwell & Yanocha, 2016; Luz, 2021). If bicyclists can maintain momentum, bicycling becomes easier on a physical level and reduces the concern over wear and tear of the joints (Tekle, 2017; Welsh, 2021). Furthermore, when bicyclists have to stop and get back up to speed, they are the least stable, which is especially concerning for new bicyclists (Bernardi, 2019; George, 2017).

There is no doubt that rolling through a stop sign is more efficient for bicyclists. Any reduction in speed must be counteracted by a brief acceleration to regain speed. That acceleration is achieved by faster or stronger pedaling. This represents a greater workload compared to simply coasting through an intersection. Precise energy demands depend on many factors, including a bicyclist's weight, gear and tire characteristics, roadway incline, and others (Haron, n.d.). Fajans et al. (2001) made a general statement that "[a] cyclist who rolls through a stop at 5 mph needs 25 percent less energy to get back to 10 mph than a cyclist who comes to a complete stop." Other statistics in the same study indicate that stopping at a stop sign adds 9.6 seconds to a bicyclist's travel time over 2.25-mile trip.[18]

As an aspect of the safety and operational efficiency claims made rolling stops also may reduce bicyclists' time in intersections. Researchers at the University of California at Davis timed and categorized bicycle crossings at ten signalized intersections near campus. The average speed for rolling stops was 11.24 ft/s compared to 16.03 ft/s for complete stops (entirely stopped at a red light) (Rubins & Handy, 2005). At crossing distances of 100 feet, these speeds translate to 6.3 seconds for rolling stops and 8.8 seconds for complete stops.

Another supportive claim for a SAY law is that coming to a complete stop impedes vehicular traffic. The policy director for Bicycle Colorado claimed that the law would "create smooth traffic flow of both bicyclists and people driving because that's where most of the interactions occur, in the intersection" (Straeger, 2019).

Limited research has demonstrated the effects of complete stops on travel and intersection-clearing speeds. Fajans et al. (2001) measured one researcher's 2.25-mile ride along two parallel streets: one with 4 stops (red signals) and another with 22 stops (21 stop signs and one red signal) while maintaining a constant rate of exertion (determined by heart rate). The average speed on the road with many stops (10.9 mph) was 3.3 mph slower than on the road with few stops (14.2 mph).

[18] Fajans and Curry (2001) found that a 2.25-mile trip with 4 stops averaged 14.2 mph and a parallel roadway with 22 stops averaged 10.9 mph. This represents travel times of 9.5 and 12.4 minutes, respectively. The difference in travel times, 2.9 minutes, divided by the difference in stops, 18, equals 0.16 minutes (9.6 seconds).

Bicyclist Volumes

People generally engage in an activity more when it is easier to do so (Thaler & Sunstein, 2009). SAY law proponents point to operational efficiency, claiming that the law removes a barrier to efficient travel and thus encourages bicycling (Associated Press, 2020; Caldwell & Yanocha, 2016; Stewart, 2017; Straeger, 2019). Other supporters claim that SAY encourages biking because gas prices make driving a less attractive mode of choice (Rosenberg, 2008).

This review did not identify any literature that specifically documented the effect of a SAY law on bicycling volumes. However, several researchers have explored factors associated with choosing to bicycle and the choice of specific routes. A small study ($N = 1$) observed a reduction in average speed on a 2.25-mile route with 22 stops compared to a parallel route with 4 stops and concluded that "reducing the number of stop signs on designated bike routes would make bicycle commuting considerably more attractive to riders" (Fajans & Curry, 2001).

Dill & Gliebe (2008) tracked 164 bicyclists in Portland with GPS units and asked them to rank factors influencing trip choice. Minimizing trip distance emerged as the most important factor. Reducing wait time at stop signs and signals ranked 4th of 7 for work, school trips, and errands, and even lower for other tip types (social, exercise, going home). Similarly, a Canadian survey of 1,402 current and potential bicyclists found that having "to stop at many stop signs on the route" was associated with a modest reduction in the likelihood of choosing to cycle for a hypothetical trip. However, factors concerning safety were much more influential (Winters et al., 2011).

Two stated preference surveys made consistent findings. Avid bicyclists in Texas indicated a tendency to avoid routes with stop-controlled intersections and that while travel time was the most important route attribute, delay caused by traffic controls was among the least important (Stinson & Bhat, 2003). A separate but related survey found that respondents were less likely to choose routes with "a high number of traffic controls and cross-streets" but indicated that travel time and motorized traffic volume were the most important attributes (Sener et al., 2009). In addition, researchers used the stated preference methodology to estimate tradeoffs between route attributes and time: commuter bicyclists were willing to add 7.5 minutes to a trip to avoid 3-5 stop signs, red lights, or cross-streets.

Empirical Analysis

In general, those who support SAY laws claim that bicyclists already do this for various reasons: that it improves safety, reduces the burden on law enforcement, is more efficient, and encourages bicycling, thereby promoting health and the environment. Those who are critical of SAY laws state that bicyclists should obey the same laws as drivers and question the impacts on bicyclist safety and volumes. Researchers have documented various behaviors surrounding SAY laws, but few have directly examined their effects.

The research team conducted an empirical analysis using existing data of various forms and sources. The question of whether to adopt a SAY law is fraught with anecdotes and emotional arguments. This analysis seeks more objective outcomes. The following sections describe the sites selected, data acquisition and preparation steps, and statistical methods used.

Site Selection

MSAs served as sites for this analysis. Biking and related injuries occur primarily in urban and suburban areas. There is no standard definition of suburban areas, but MSAs offer a solution. MSAs comprise one or more counties surrounding a principal city or cities. For this study, the areas outside the principal towns in each MSA were considered suburban. MSAs are named after their principal cities. For example, the Dover MSA in Delaware contains the county of Kent and the city of Dover. This report references sites by their MSA names unless otherwise specified. Figure 2 maps the 8 selected sites. Sites are organized into four distinct groups, each containing one test site and one control site.

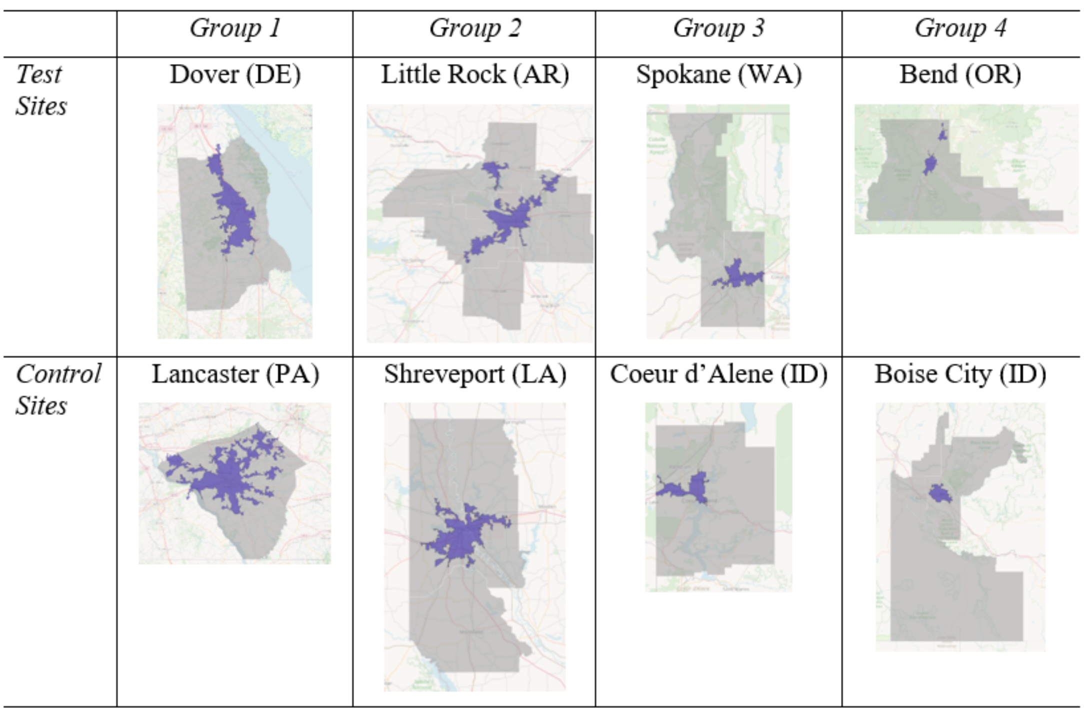

Figure 2. Test and control sites by group

Test sites were chosen primarily according to when they enacted SAY laws: Delaware in October 2017, Arkansas in July 2019, Oregon in January 2020, and Washington in October 2020. Oklahoma, North Dakota, Colorado, and Utah enacted SAY laws between 2021 and 2022, which was determined to be too recent for this study. One MSA was chosen in each State to serve as a test site. Corresponding control sites were selected from neighboring States (Pennsylvania, Louisiana, and Idaho) to minimize geographic and cultural differences. As Idaho borders both Washington and Oregon, two MSAs were chosen: Coeur d'Alene and Boise City. These MSAs correspond to Spokane, Washington, and Bend, Oregon. Idaho enacted the SAY in 1982 but is being treated as a control State for Spokane and Bend. Traditionally, a before-and-after comparison of two sites looks for diverging trends as one site implements an intervention and the other remains unchanged. In this case, however, a convergence of crash rates would indicate that crash rates were different when one State had the law and the other did not, and then became similar when the law was in effect in both States. Table 5 shows the enactment date in each group and the beginning and ending of the 24-month pre- and post-law observation periods.

Table 5. SAY enactment data and pre- and post-law periods by group

Group	**Pre-Law Period Beginning**	**SAY Enactment**	**Post-Law Period Ending**
1. Dover and Lancaster	September 2015	October 2017	November 2019
2. Little Rock and Shreveport	June 2017	July 2019	August 2021
3. Spokane and Coeur d'Alene	September 2018	October 2020	November 2022
4. Bend and Boise City	December 2017	January 2020	February 2022

Data

The sections below describe each data source and the steps taken to estimate or extract all necessary data elements.

Crash Records

SAY laws are intended to affect stop- and (sometimes) signal-controlled intersections. For purposes of this study, crashes at or near intersections were considered relevant; crashes *at* intersections may be the direct result of a bicyclist or driver failing to yield the right-of-way, while crashes *near* intersections may be the result of rear-ending bicyclists as they decelerate or regain speed. The research team acquired relevant crash data from various sources: NHTSA's State Data System (Dover) and Electronic Data Transfer program (Little Rock), self-service open data portals (Lancaster, Bend, Coeur d'Alene, and Boise City), and directly from State DOTs in response to formal requests (Shreveport and Spokane). Availability of data elements varied by site. Not all data elements were universally available. Table 6 shows which elements were available for each site. Lack of data did not prevent the analysis of crash rates but limited some secondary analyses.

Table 6. Crash data elements available for each site

	Group 1		Group 2		Group 3		Group 4	
Data Element	**Dover**	**Lancaster**	**Little Rock**	**Shreveport**	**Spokane**	**Coeur d'Alene**	**Bend**	**Boise City**
Age	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Alcohol involvement	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Collision type	Yes	Yes	No	Yes	No	No	Yes	No
Driver State residency	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Contributing factors (bicyclist)	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Contributing factors (driver)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Helmet use	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Hit-and-run indicator	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Injury severity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Latitude, longitude	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lighting condition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Race	Yes	No	Yes	No	No	No	No	No
Sex	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Traffic control device present	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Urban/suburban indicator	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes

Crash records from some sites included a data element capturing the city in which the crash occurred. For others, city was derived by passing the crash coordinates to an Open Street Maps application programming interface that accepts latitude and longitude coordinates and returns a wealth of information, including the street address, road name, city, county, and postal code. Crashes were then labelled as urban if they occurred in principal cities, and suburban otherwise. Table 7 and Table 8 tabulate the number of urban and suburban crashes at stop- and signal-controlled intersections in each site 2 years before and after a SAY law was enacted (with the same timeframe applied to associated control sites).

Table 7. Crashes at stop-controlled intersections by urbanicity in the two years before and after enacting SAY laws in each test site

		Urban		**Suburban**	
		Before	**After**	**Before**	**After**
Group 1	Dover (test)	2	5	5	2
	Lancaster (control)	17	13	23	15
Group 2	Little Rock (test)	17	23	7	5
	Shreveport (control)	5	12	3	2
Group 3	Spokane (test)	12	4	6	0
	Coeur d'Alene (control)	48	43	16	10
Group 4	Bend (test)	12	14	2	4
	Boise City (control	72	34	45	26

Table 8. Crashes at signal-controlled intersections by urbanicity in the two years before and after enacting a SAY law in each test site

		Urban		**Suburban**	
		Before	**After**	**Before**	**After**
Group 1	Dover (test)	7	7	4	1
	Lancaster (control)	17	5	11	12
Group 2	Little Rock (test)	15	11	2	3
	Shreveport (control)	13	8	0	0
Group 3	Spokane (test)	8	2	2	2
	Coeur d'Alene (control)	38	44	7	10
Group 4	Bend (test)	7	5	0	0
	Boise City (control	46	34	22	16

Note that only the SAY law in Arkansas includes a red-light provision, allowing bicyclists to proceed through a signalized intersection after coming to a complete stop, checking the intersecting roadways, and yielding the right-of-way to any vehicles. However, bicyclists in States without red light provisions may mistakenly believe that this maneuver is also permitted. Crashes at signal-controlled intersections were therefore considered in the analysis. Similarly, Delaware's law is restricted to two-lane roadways; because road users may be unaware of this restriction, the analysis was not limited to these roadways.

Volumes

Both bicyclist and motorist volumes were considered in this analysis. These metrics quantify the opportunity for crashes to occur. All else equal, places with higher levels of biking and/or driving experience more interactions between the two road users; similarly, periods of greater biking (i.e., months with moderate temperatures) exhibit more interactions. As this analysis was conducted on a monthly scale that coincided with the COVID-19 pandemic, monthly volumes are important to capture the cyclical change in the opportunity for crashes. The research team developed methods to estimate monthly urban and suburban volumes for each site. These metrics differ by road user type (bicycle commuters and vehicle miles driven) but serve as an index of travel for each mode.

Bicyclist Volumes

Local, persistent, automated bicycle counters would produce the most reliable, precise measures of bicyclist volumes. Conversations with DOT personnel, bicycle advocacy groups, and others failed to identify any such data. Instead, bicyclist volumes were estimated using a combination of data from the Census Bureau's American Community Survey (ACS) and Strava Metro (SM).

The ACS is an ongoing survey conducted by the Census Bureau designed to collect detailed information about the demographic, social, economic, and housing characteristics of the American population. The ACS replaced the long-form decennial census questionnaire in 2005 and has since provided more frequent and up-to-date data on a wide range of topics. SM is a platform and service offered by Strava, a popular fitness tracking app for bicyclists and runners. While Strava primarily focuses on individual fitness tracking and social networking in the athletic community, Strava Metro is specifically geared toward providing aggregated and anonymized data to urban planners, transportation agencies, and city governments. ACS table S0801 reports the percentage of workers who, "usually [got] to work LAST WEEK [by] bicycle" (U.S. Census Bureau, 2022b; U.S. Census Bureau, 2022c). It is important to note that the answer to this question is highly dependent on when someone responds. The annual number of bicycle commuters in each site was derived by multiplying (a) the percentage of workers who commuted by bike and (b) the number of workers in each MSA.

The research team then used SM data to decompose the annual estimates into monthly urban and suburban volumes. The percentage of commute trips in each month in 2019 at each site showed a basis for the annual-to-monthly conversion. SM also provides leisure trips, but commute trips were used to better align with the annual number of commuters derived from the ACS data. Trip origin data from 2019 showed a basis for partitioning bicyclist volumes into urban and suburban trips by determining the percentage of trips originating from the MSA's principal city or cities. The area in each MSA was classified as urban or suburban. Principal cities determined the urban area, while the rest of an MSA was considered suburban. Note that areas outside of MSAs are considered rural and excluded from this analysis. Trips that originated in principal cities were considered urban, while trips that originated elsewhere in MSAs were considered suburban. Figure 3 shows the results of these calculations.

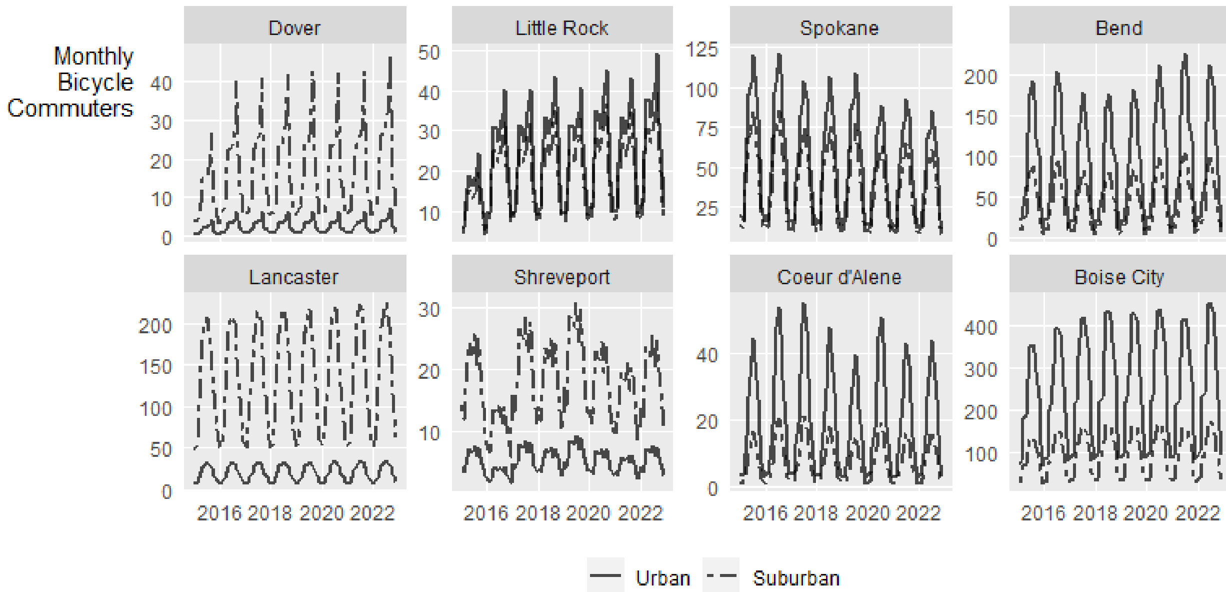

Figure 3. Monthly urban and suburban bicyclist volumes (bicycle commuters) at each site

Motorist Volumes

Motorist volumes underwent a similar estimation process using different data sources: (1) FHWA's *Highway Statistics* series (Table HM-7, daily vehicle miles travelled for MSAs), (2) trips by distance produced by the Maryland Transportation Institute (MTI) for the Bureau of Transportation Statistics to monitor travel behaviors during the COVID-19 pandemic (Maryland Transportation Institute, 2023), and (3) Local Area Transportation Characteristics by Household (LATCH) data (Bureau of Transportation Statistics, 2023). LATCH uses data from the National Household Travel Survey to estimate average weekday household travel for all Census tracts in the United States. The procedure is described and visualized below:

1. Collect annualized daily vehicle miles travelled (DVMT) from FHWA's *Highway Statistics* for 2015-2019.

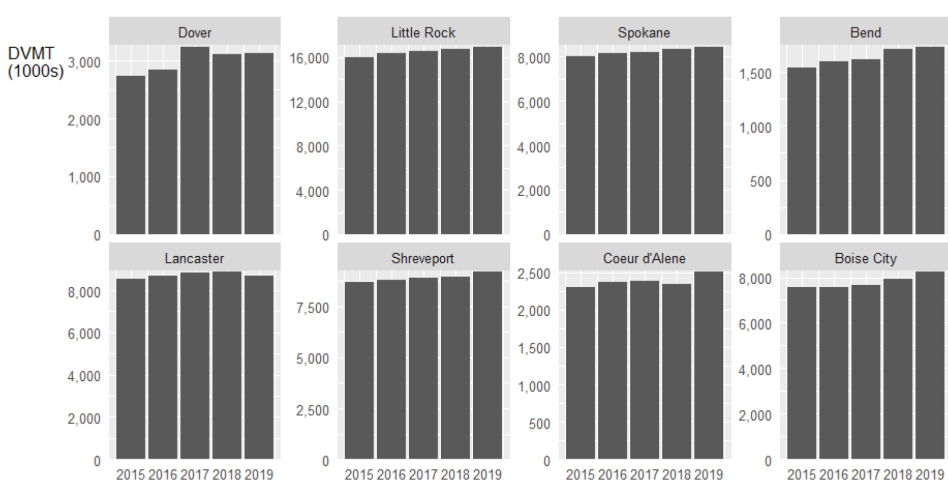

Figure 4. Annualized daily vehicle miles travelled by MSA

2. Use MTI data (trips by distance, 2019 only) to develop monthly adjustment factors for each MSA. These factors reflect the volume in each month relative to the average for each year and MSA; values greater than 1 correspond to months with above-average volumes.

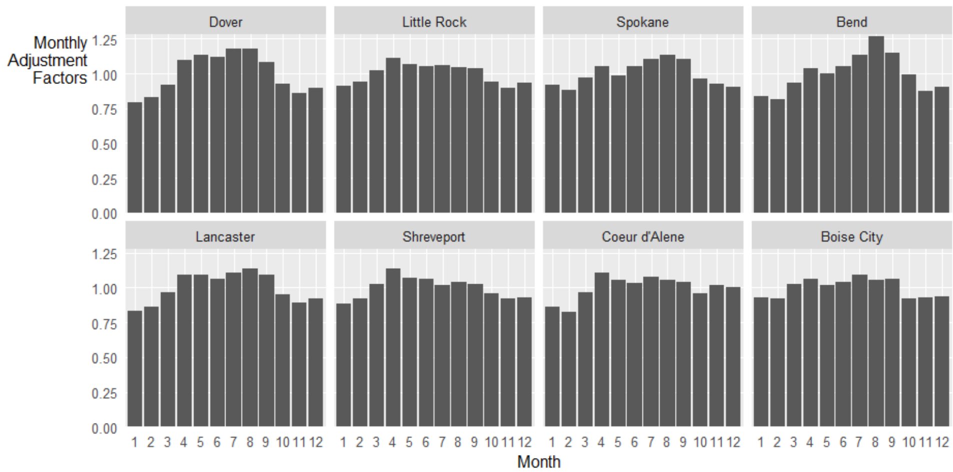

Figure 5. Daily vehicle miles travelled adjustment factors by month and MSA

3. Estimate pre-COVID monthly DVMT in each MSA by multiplying the annual DVMT metrics by monthly adjustment factors.

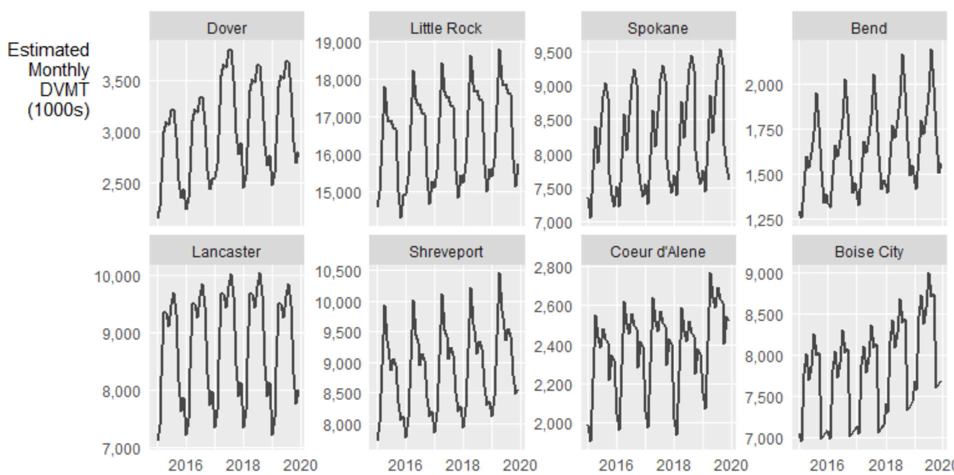

Figure 6. Estimated pre-COVID daily vehicle miles travelled by month and MSA

4. Calculate monthly DVMT in 2020 and beyond using the MTI trips by distance data by multiplying the number of trips of each respective distance. As trip distances are given in ranges, the midpoint was used for this calculation. For example:

$$500 \text{ trips of 1-3mi} \rightarrow 500 \times \left(\frac{1+3}{2}\right) = 1000 \text{ vehicle miles travelled.}$$

5. Calculate ratios of monthly DVMT for each year relative to 2019 using the MTI data. For example:

$$\frac{DVMT^{MTI}_{Jan\,2020}}{DVMT^{MTI}_{Jan\,2019}}, \frac{DVMT^{MTI}_{Feb\,2020}}{DVMT^{MTI}_{Feb\,2019}}, \dots, \frac{DVMT^{MTI}_{Dec\,2022}}{DVMT^{MTI}_{Jan\,2019}}$$

6. Estimate DVMT in 2020 and beyond by multiplying the monthly DVMT in 2019 by the corresponding DVMT ratio:

$$DVMT_{Jan\,2020} = DVMT_{Jan\,2019} \times \left(\frac{DVMT^{MTI}_{Jan\,2020}}{DVMT^{MTI}_{Jan\,2019}}\right)$$

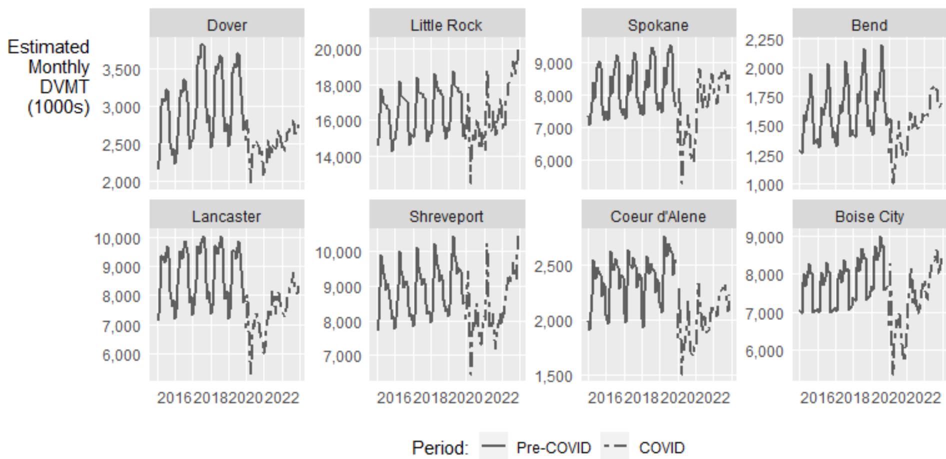

Figure 7. Estimated daily vehicle miles travelled before and after COVID by month and MSA

7. Use the LATCH data to estimate urban and suburban DVMT.

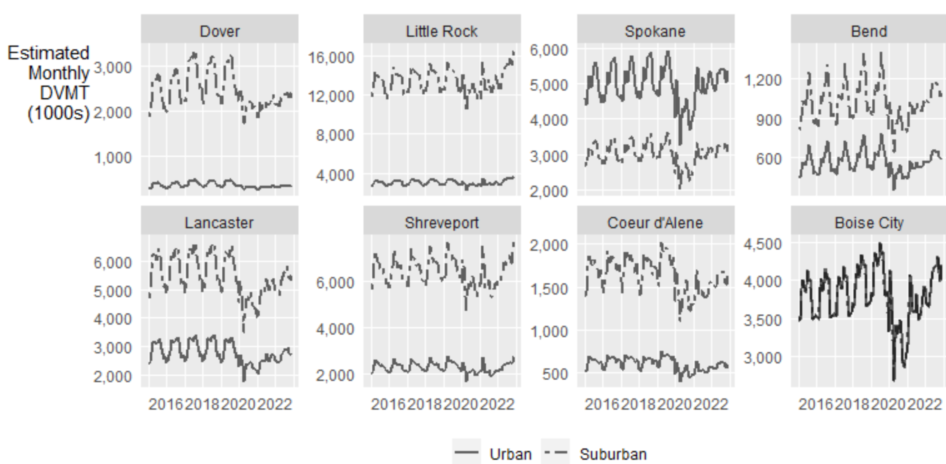

Figure 8. Estimated daily vehicles miles travelled before and after COVID by month, urbanicity, and MSA

Complete Datasets

Figure 9 to Figure 12 juxtapose the crash rates and volumes for each site pair, centered on the month in which the test site enacted a SAY law. Note that the same volumes were used for both intersection types for a given urbanicity.

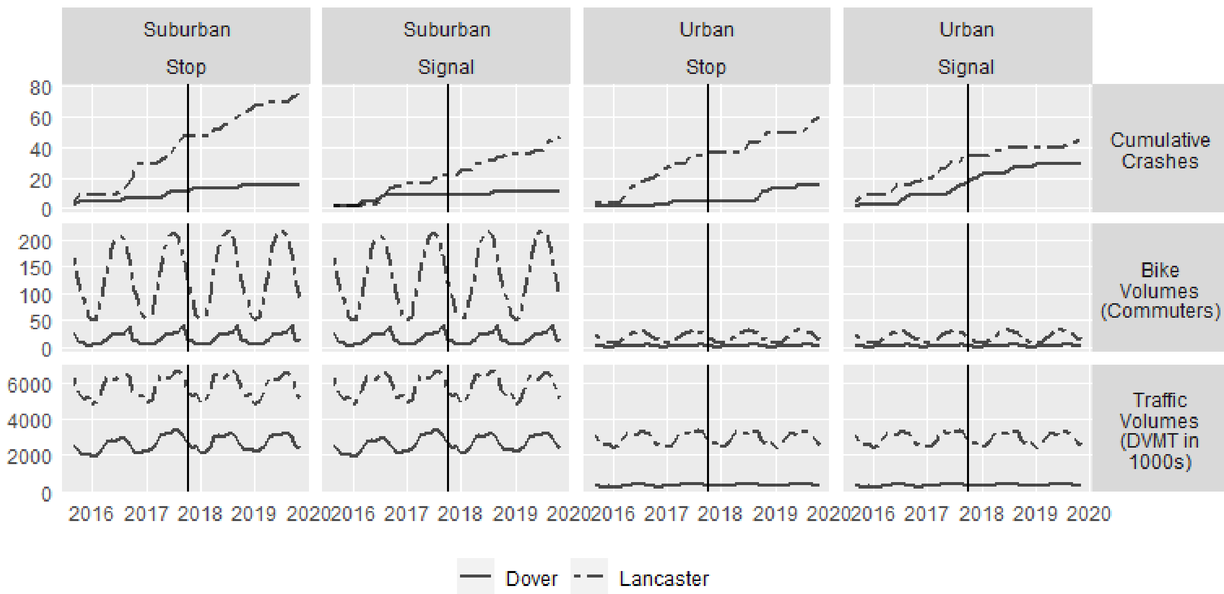

Figure 9. Crashes and volumes for Dover and Lancaster

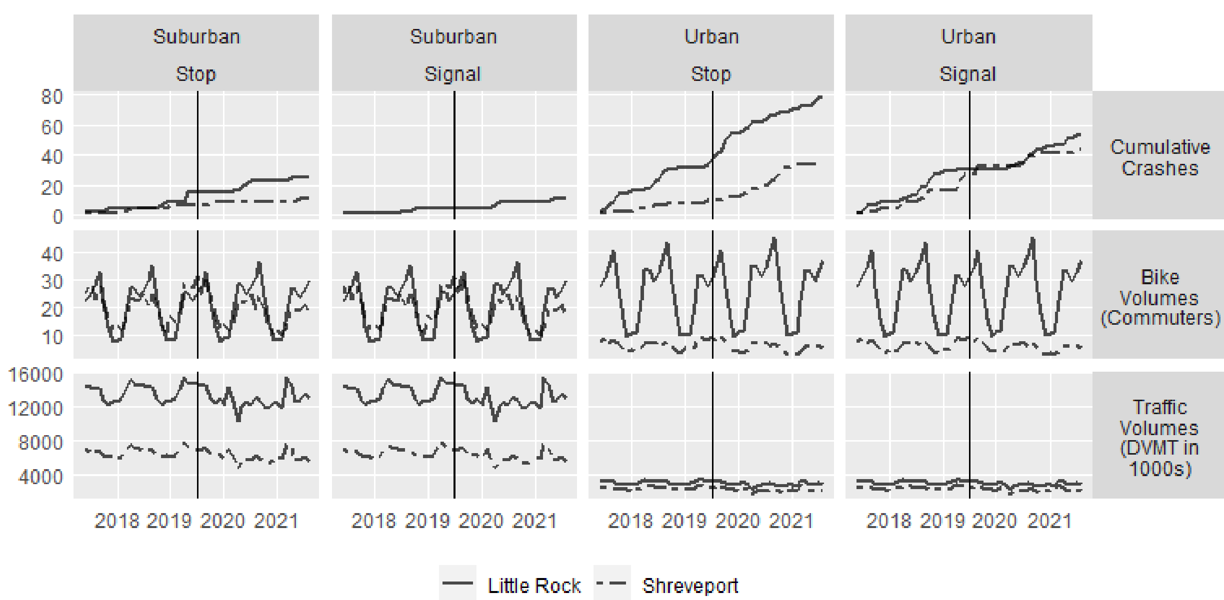

Figure 10. Crashes and volumes for Little Rock and Shreveport

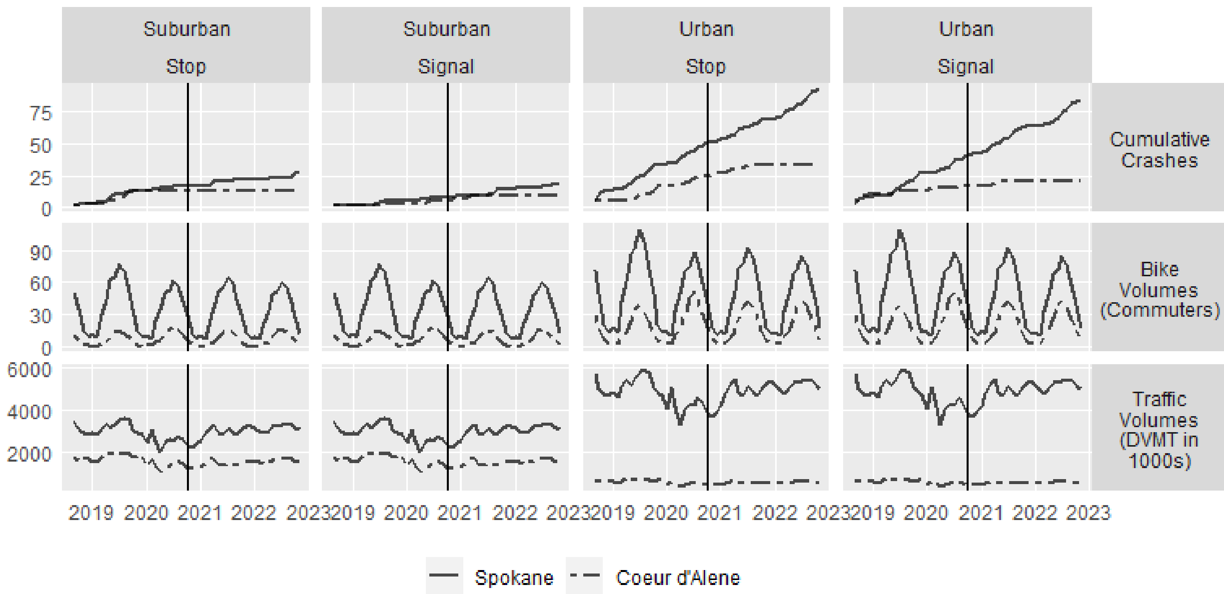

Figure 11. Crashes and volumes for Spokane and Coeur d'Alene

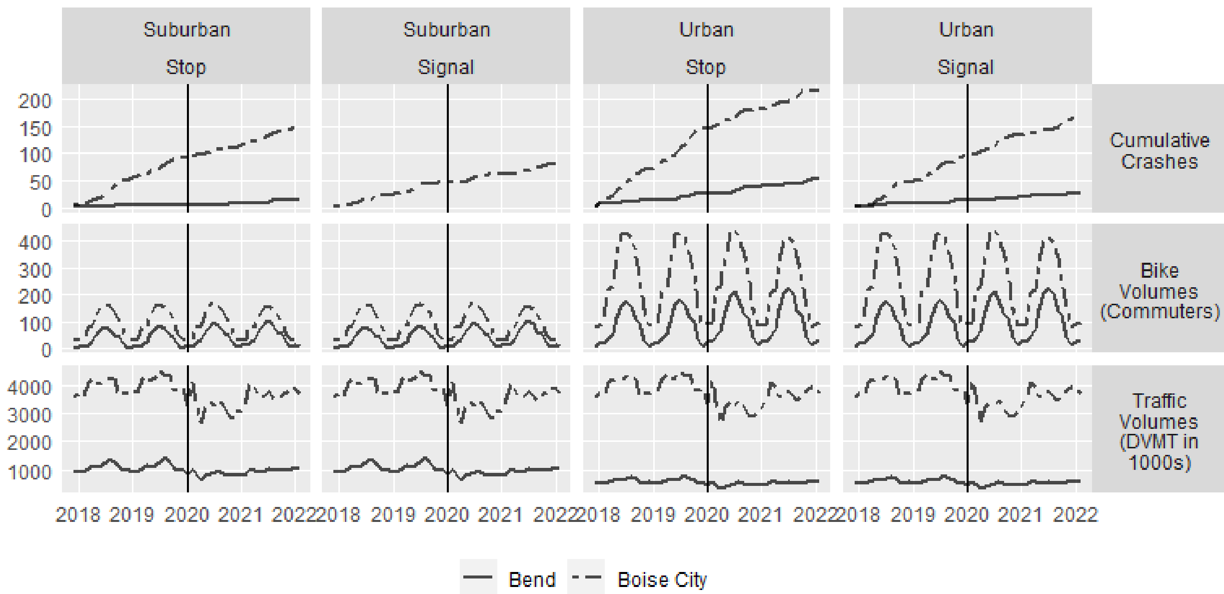

Figure 12. Crashes and volumes for Bend and Boise City

Statistical Analysis

The research team combined crash and volume data and SAY law enactment dates to produce a complete dataset. Statistical models estimate the cumulative number of urban/suburban stop/signal-controlled intersection crashes (separately) as a function of time (months until/after enacting a SAY law), whether the law was in effect (1 if so, 0 otherwise), and volumes. The slope of this line (cumulative crashes) with respect to time represents a monthly crash rate. If this line becomes completely flat, then all crashes have been eliminated. If it increases in slope, crashes are occurring more often, and bicyclist safety has worsened. If the rate of crashes falls in a test MSA after enacting the law, and by a greater degree than in the control MSA, then the law has improved bicyclist safety. In other words, the interaction of time and whether the law was in effect provides a formal test for the law's effect on crash rates. Log-transforming the cumulative number of crashes and volumes provides an elasticity: the percent-change in monthly crashes attributable to a one-percent change in volumes.

In addition to crash rates, the research team conducted secondary analyses into crash locations and socioeconomic factors, bicyclist injury severity, age, race, sex, and both bicyclist and driver crash-contributory behavioral factors. Linear models were used to formally test for differences in injury severity pre- and post- law enactment by converting injury severity to a linear scale. These models also accounted for bicyclist age, sex, helmet use, and alcohol involvement, where such data was available.

Results

Results for each analysis are presented below.

Crash Rates

Statistical models estimated monthly crash rates for all sites while accounting for variations in volumes. Each model includes an interaction term for date and whether the law was in effect or not. Table 9 presents the corresponding coefficients as the percentage decrease in monthly crash rates attributable to a SAY law. For example, in Dover, the rate of bicyclist-involved crashes at suburban stop-controlled intersections fell by 5.0 percent *more* than in Lancaster ($p < 0.01$). This can be confirmed with the crash counts in Table: the decrease in total (two-year) crashes at suburban stop-controlled intersections is larger in Dover (60%) than in Lancaster (35%). Note that volumes also exerted a statistically significant effect on crash rates. Groups 3 and 4 use MSAs in Idaho as control sites (as the law was in effect in Idaho throughout the entire observation period). As such, the corresponding statistics in the table indicate the difference in crash rates before the law was enacted in the test sites; after which point, rates became statistically indistinguishable. Overall, safety improvements were largest at suburban stop-controlled intersections and urban signal-controlled intersections. None of the four test sites experienced an increase in crashes attributable to enacting a SAY law.

Table 9. Estimated decrease (%) in monthly crash rates attributable to SAY laws

	Suburban		Urban	
Group	**Stop**	**Signal**	**Stop**	**Signal**
1. Dover (test) and Lancaster (control)	5.0^{***}	6.1^{***}	0.8	2.9^{***}
2. Little Rock (test) and Shreveport (control)	1.3	NA	3.6^{***}	3.7^{***}
3. Spokane (test) and Coeur d'Alene (control)	5.6^{***}	1.9^{**}	2.9^{***}	6.3^{***}
4. Bend (test) and Boise City (control)	7.9^{***}	NA	3.7^{***}	5.5^{***}

Note: $^{**}p < 0.05$, $^{***}p < 0.01$. NA indicates cells with zero corresponding crashes at either the test or control site.

Socioeconomics and Demographics

To explore potential inequities in SAY-related crashes, the research team mapped crashes in the context of selected socioeconomic factors and explored bicyclist age and race/ethnicity.

Except for Lancaster, all sites exhibit a cluster of crashes in or near the principal city. Three metrics related to equity were considered. Figure 13 shows crashes in relation to the percentage of households in each Census tract that rent, as opposed to own, their home. The percentage of renters in an area can have varying effects on bicyclist safety. Areas with a higher percentage of renters may experience higher population turnover (Garcia & Berchick, 2023), resulting in less familiarity with local traffic patterns and road conditions. This lack of familiarity could potentially increase the risk of crashes involving bicyclists. Additionally, transient populations may be less engaged in advocating for bicyclist safety measures or participating in community initiatives. However, it's important to note that the correlation between renter percentage and bicyclist safety may vary depending on other factors such as infrastructure, community engagement, and local enforcement.

Figure 14 uses a related metric, the percentage of single-family homes. The percentage of single-family homes can influence bicyclist safety through several mechanisms. Single-family home neighborhoods often have lower population densities (Gonzalez & Van Gorder, 2020) and less traffic congestion (Khattak & Rodriguez, 2005), creating a more favorable environment for bicyclists. These neighborhoods may also have implemented traffic calming measures and invested in bicyclist-friendly infrastructure, such as dedicated bike lanes and shared-use paths. These factors can contribute to improved safety outcomes for bicyclists in areas with a higher percentage of single-family homes.

Figure 15 shows crashes in relation to income inequality. Income inequality can indirectly impact bicyclist safety in multiple ways (Neptune, 2022). Areas with high levels of income inequality may have limited access to resources and funding for infrastructure improvements, including bicyclist safety measures. Crashes involving vehicles and bicyclists occur at higher rates in lower-income neighborhoods (Mitsova et al., 2021), and residents of these areas are more likely to lack access to a vehicle, forcing them to rely on other means of transportation, including walking and bicycling (Mengedoth, 2023).

No clear pattern emerges from these maps, other than the strong tendency for crashes to occur in or near principal cities. This suggests that urbanicity and the built environment is more influential than socioeconomic factors.

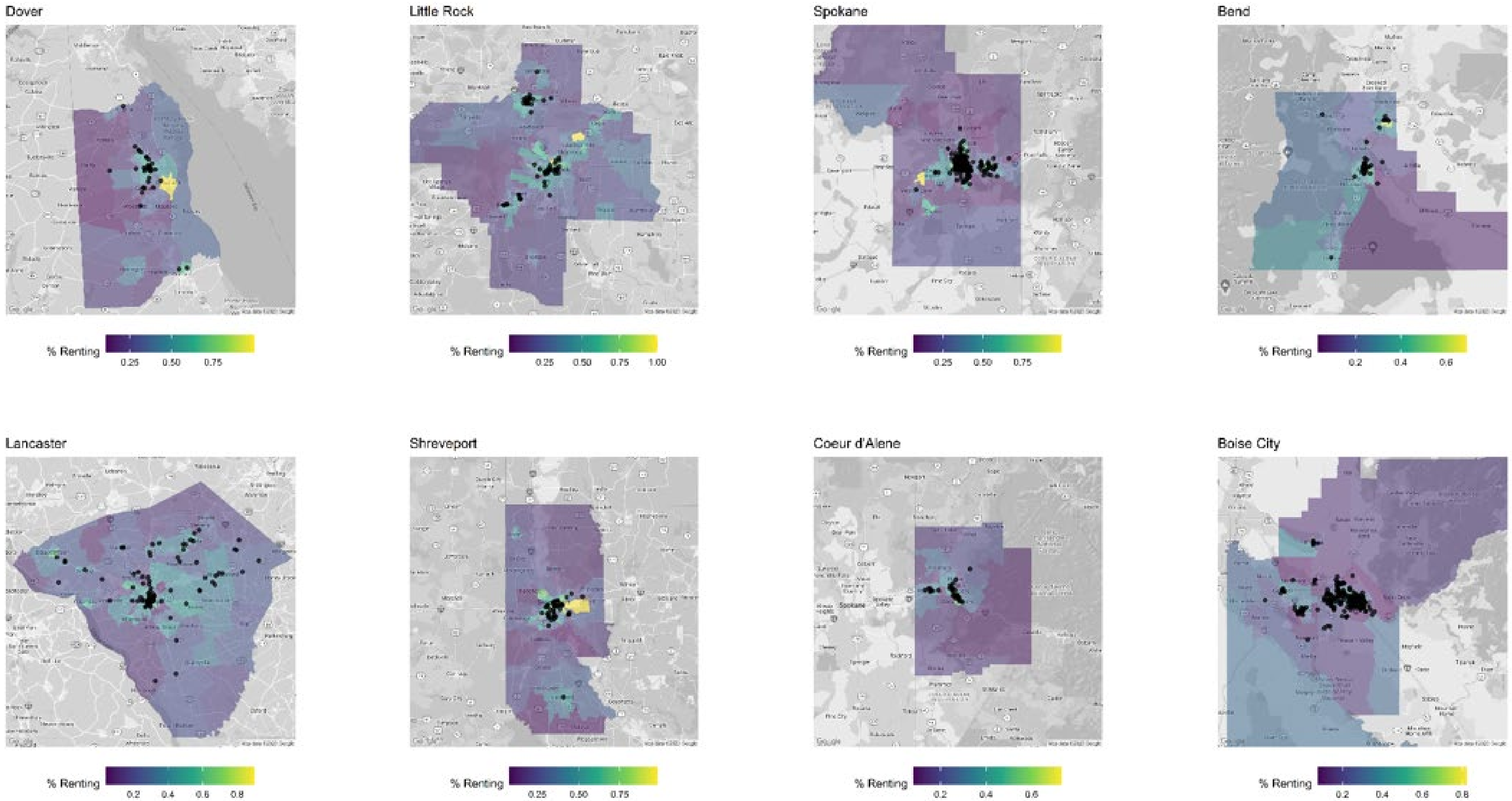

Figure 13. Crashes in relation to the percentage of households that rent

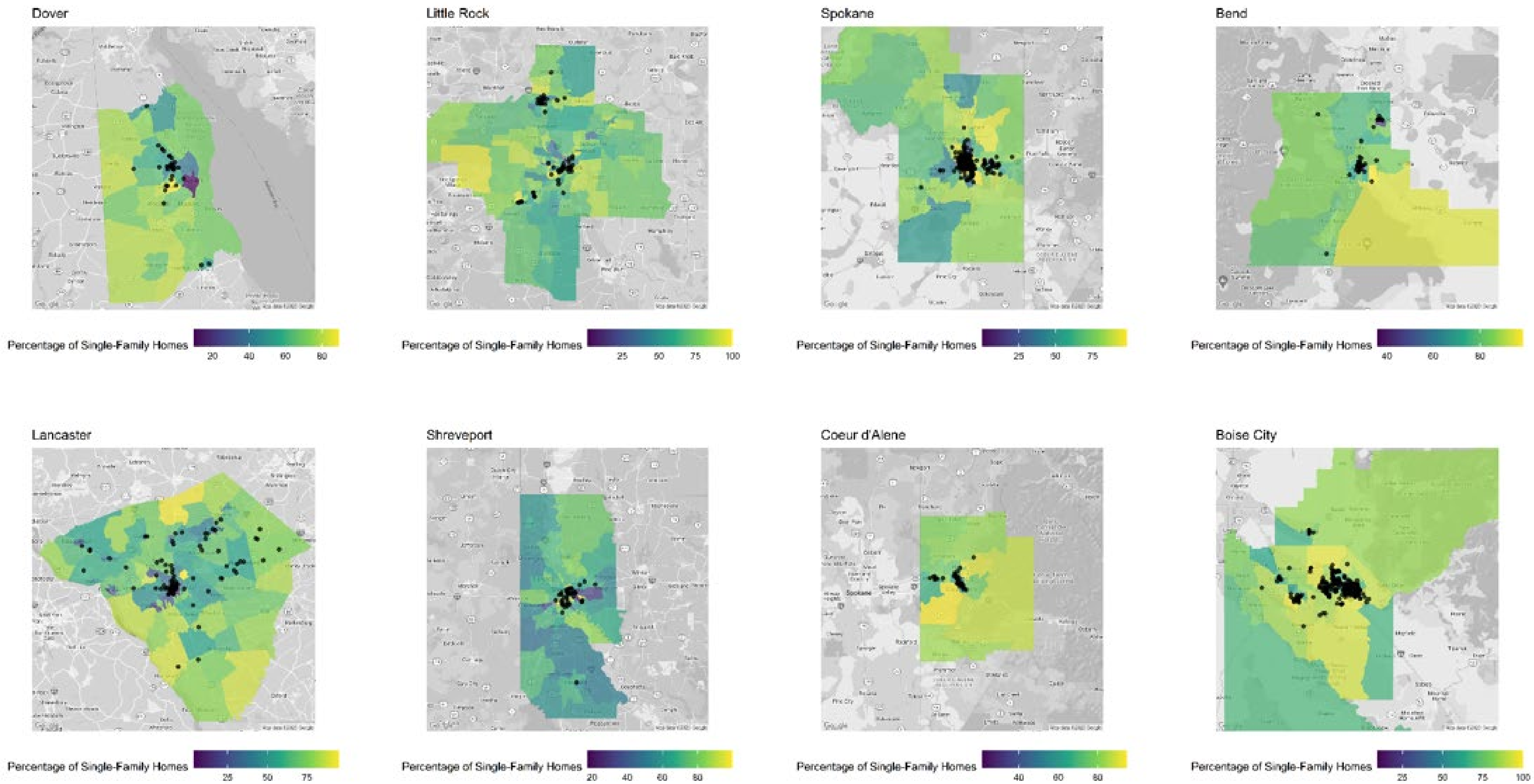

Figure 14. Crashes in relation to single-family homes

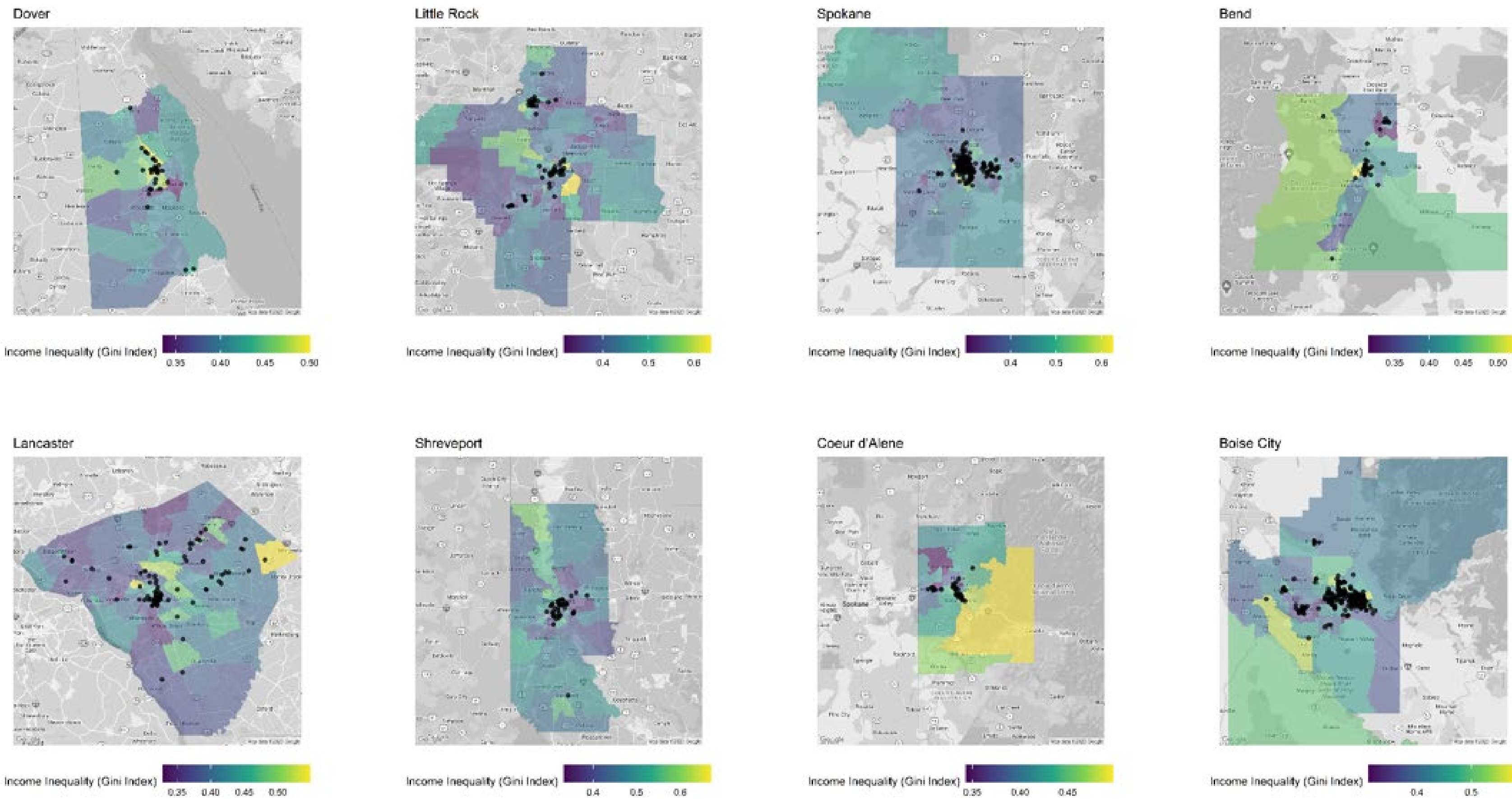

Figure 15. Crashes in relation to income inequality

Crash records from Dover and Little Rock shown the race/ethnicity of people involved in crashes, shown in Table 10. This data was unavailable for all other sites. Black/African-American bicyclists are over-represented in both: 26 percent of residents in Dover identify as Black/African-American, while they make up nearly half (48%) of the bicyclists involved in SAY-related crashes; similarly, 23 percent of the residents of Little Rock are Black, compared to 42 percent of bicyclists involved in SAY-related crashes (U.S. Census Bureau, 2022a).

Table 10. Race/ethnicity of bicyclists involved in SAY-related crashes by site

Site	Race/Ethnicity	Before	After	Total
Dover	Black/African-American	11	5	16 (48%)
	White/Caucasian	7	10	17 (52%)
Little Rock	Black/African-American	13	20	33 (42%)
	White/Caucasian	26	17	43 (55%)
	Asian/Pacific Islander	0	1	1 (1%)
	Hispanic	0	1	1 (1%)

The sex of bicyclists involved in SAY-related crashes is consistently and predominantly male, as shown in Table 11. This data was unavailable for Spokane. Across all sites, 80 percent of these bicyclists were male, both before and after SAY adoption. The percentage of male bicyclists fell slightly in test sites (from 87% to 81%) and increased slightly in control sites (from 78% to 80%). These differences were not statistically significant ($p > 0.05$). A lack of change in the percentage of male bicyclists suggests that SAY laws do not affect male and female bicyclists differently. A significant increase in the percentage might suggest that male bicyclists began performing more rolling stops than before, without fully complying with the law's requirement to yield the right-of-way to vehicles in or approaching intersections.

Table 11. Count and percentage of male bicyclists involved in SAY-related crashes by site

Site	Before		After	
	N	%	N	%
Dover (test)	15	83%	14	93%
Lancaster (control)	55	87%	37	86%
Little Rock (test)	36	90%	30	75%
Shreveport (control)	17	89%	17	81%
Coeur d'Alene (control)	21	75%	8	100%
Bend (test)	18	86%	19	83%
Boise City (control)	136	74%	84	76%

Injury Severity

In lieu of reduced crash rates, SAY laws have the potential to improve bicyclist safety by reducing crash severity. All bicyclist injuries were categorized on the KABCO injury severity scale. The KABCO scale is a functional measure of the severity of injuries caused by crashes, using a scale from K to O, as follows: fatal injury (K), suspected serious injury (A), suspected minor injury (B), possible injury (C), no apparent injury (O) (NHTSA, 2012).

Figure 16 shows bicyclist injury profiles for each MSA by urbanicity and TCD. Injury counts are aggregated over the two-year periods before and after enacting SAY laws and grouped according to the KABCO injury scale. If enacting a SAY law reduces bicyclist injury severity, the injury profiles will shift to the right, toward the less severe end of the scale. (Note that less area under the "after" curve does not necessarily indicate a reduction in crashes because these profiles do not account for volumes.) Injuries at urban signal-controlled intersections in Dover appear to become more evenly distributed across the less severe end of the scale. On the contrary, injuries at urban stop-controlled intersections in Spokane shift toward greater severity after enacting the law.

Linear models formally tested for shifts in injury severity. As with crash rate models, each injury severity model consisted of a test-control site pair and focused on one crash location type (suburban or urban, stop- or signal- controlled).

Table 12 presents the estimated shift in injury severity attributable to SAY laws. Results provide little evidence of a severity shift. Changes in average injury severity were statistically insignificant for all crash groups, except for urban crashes in Dover. There, average injury severity was 0.8 KABCO levels lower at stop-controlled intersections ($p < 0.10$) and 0.5 levels lower at signal-controlled intersections ($p < 0.10$).

Table 12. Estimated shift in injury severity (KABCO scale level) attributable to SAY laws

	Suburban		**Urban**	
Group	**Stop**	**Signal**	**Stop**	**Signal**
1. Dover (test) and Lancaster (PA, control)	-0.4	NA	-0.8^{*}	-0.5^{*}
2. Little Rock (test) and Shreveport (LA, control)	0.7	NA	-0.0	0.0
3. Spokane (test) and Coeur d'Alene (ID, control)	0.1	0.5	0.2	0.2
4. Bend (test) and Boise City (ID, control)	0.1	NA	-0.1	0.0

Note: $^{*}p < 0.10$. NA indicates cells with too few observations in either the test or control site. Models for Group 1 and 4 included bicyclist age, sex, helmet use, and alcohol involvement; model for Group 2 included bicyclist age and sex; model for Group 3 did not include any additional variables.

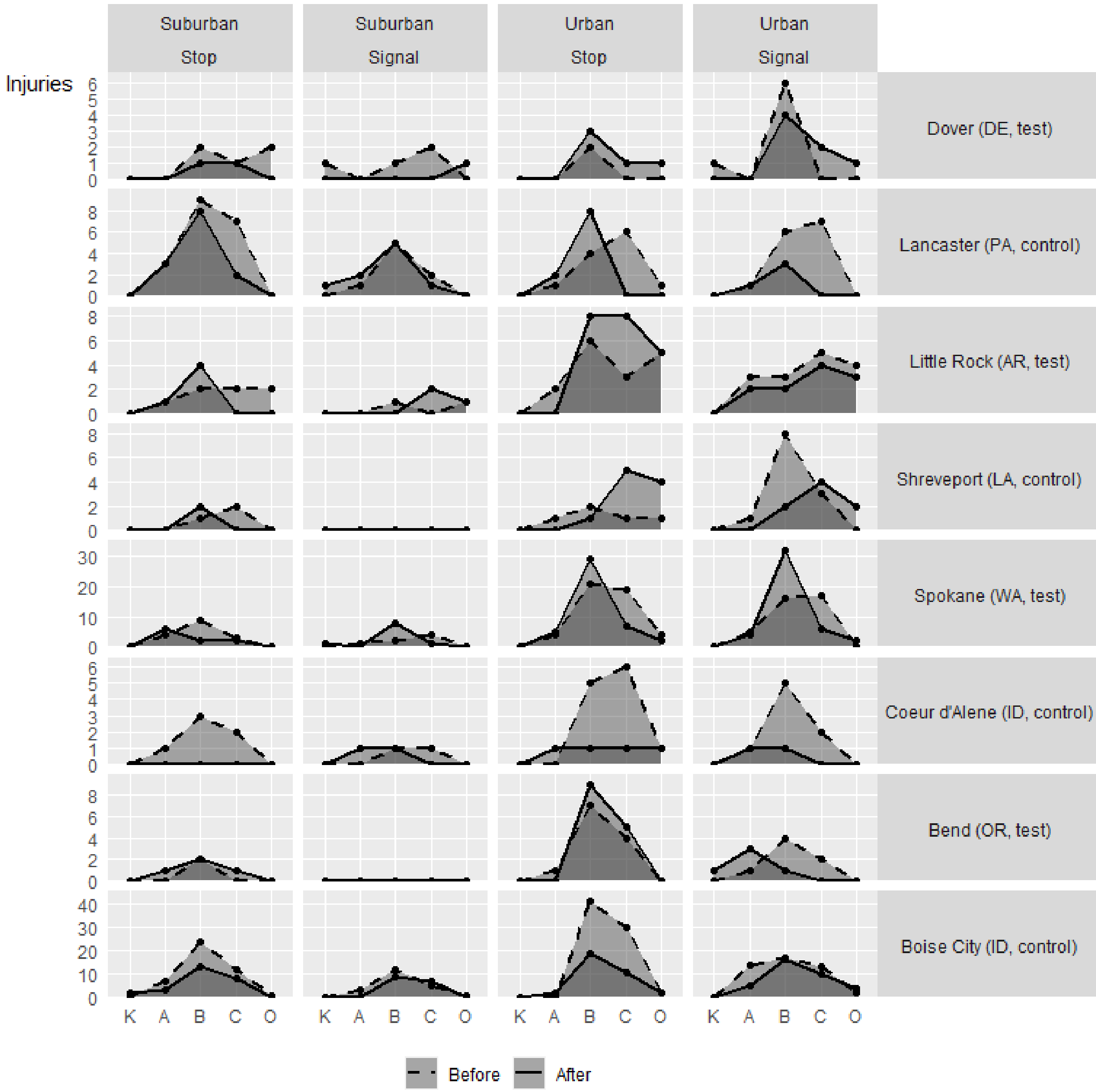

Figure 16. Bicyclist injury profiles

Bicyclist Age

Figure 17 plots the ages of bicyclists involved in SAY related crashes. The *t*-tests did not identify any statistically significant differences and the average age of bicyclists in SAY-related crashes did not decrease.

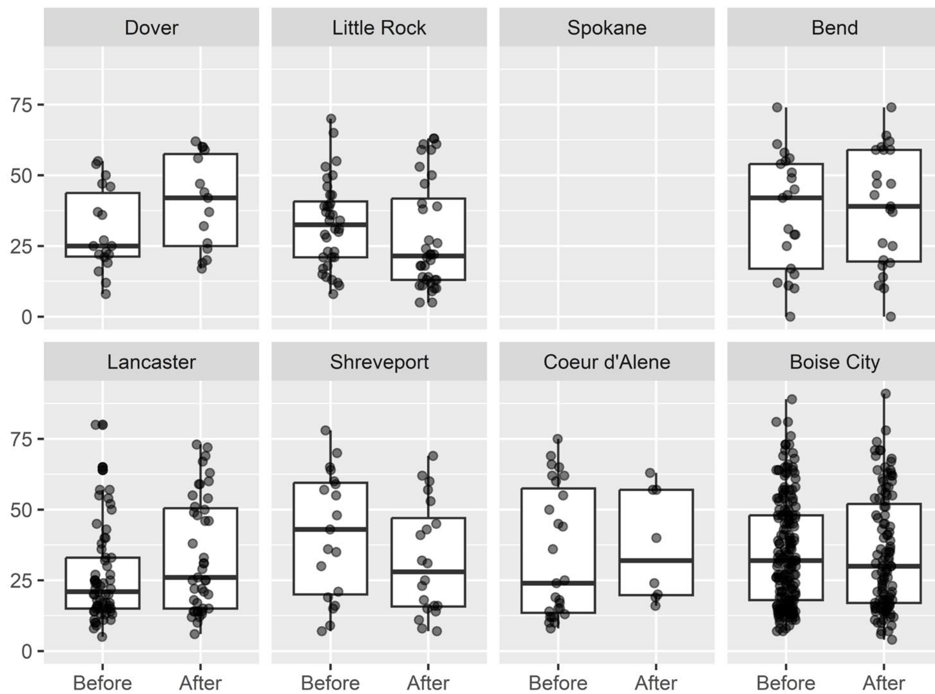

Figure 17. Ages of bicyclists involved in SAY-related crashes

Bicyclist and Driver Behavioral Factors

Crash records from some test sites included data elements describing driver and/or bicyclist behaviors thought to contribute to the crash, shown in Table 13. These should be interpreted with caution as they did not appear consistently in the data and are subject to law enforcement subjectivity. No site exhibits any notable change in behaviors relative to the enactment of SAY laws.

Table 13. Bicyclist and driver behaviors prior to crash

		Bicyclist			Driver		
Site	**Behavior**	**Before**	**After**	**Total**	**Before**	**After**	**Total**
Dover test)	Disregard TCD	4	2	6 (29%)	0	0	0 (0%)
	Fail to yield ROW	3	2	5 (24%)	5	2	7 (28%)
	None	6	4	10 (48%)	9	9	18 (72%)
Little Rock (test)	Disregard TCD	NP	NP	NP	1	0	1 (2%)
	Fail to yield ROW	NP	NP	NP	5	3	8 (15%)
	Improper turn	DO	DO	DO	1	2	3 (5%)
	None	NP	NP	NP	22	21	43 (78%)
Shreveport (control)	Disregard TCD	4	5	9 (29%)	1	0	1 (3%)
	Fail to yield ROW	4	9	13 (42%)	3	2	5 (16%)
	None	5	4	9 (29%)	9	17	26 (81%)
Spokane (test)	Disregard TCD	11	11	22 (14%)	4	5	9 (6%)
	Fail to yield ROW	16	20	36 (22%)	20	32	52 (34%)
	Follow too closely	DO	DO	DO	1	0	1 (1%)
	Improper turn	DO	DO	DO	2	2	4 (3%)
	None	48	56	104 (64%)	40	45	85 (56%)
Coeur d'Alene (control)	Disregard TCD	1	3	4 (15%)	1	0	1 (3%)
	Fail to yield ROW	4	2	6 (22%)	13	3	16 (52%)
	None	15	2	17 (63%)	9	5	14 (45%)

Boise City (control)	Disregard TCD	17	16	33 (13%)	11	5	16 (6%)
	Fail to yield ROW	19	18	37 (15%)	72	37	109 (43%)
	Improper turn	DO	DO	DO	3	4	7 (3%)
	None	120	59	179 (72%)	74	49	123 (48%)

Note: NP = not provided in crash data, DO = driver only; no data provided for Lancaster (control) or Bend (test).

Discussion

Various aspects of bicyclist safety and behavior were explored to gain a comprehensive understanding of the various effects of SAY laws. By examining these effects objectively and quantitatively, the report hopes to provide valuable information to the public.

The analysis indicates that SAY laws have the potential to reduce bicycle crashes at intersections. The decrease in monthly crash rates, particularly at suburban stop-controlled intersections and urban signal-controlled intersections, suggests that these laws may contribute to safer interactions between bicyclists and drivers.

It is important to note that the observed reduction in crash rates was not uniform across all sites and intersection types. The effectiveness of SAY laws may vary depending on the specific road conditions, infrastructure, and traffic patterns of each MSA. Nonetheless, the overall trend of decreased crash rates at certain intersections is a promising indicator of the potential benefits of SAY laws in mitigating bicycle crashes.

This observational research did not identify the specific mechanism by which SAY laws reduce crashes, but there are several possible explanations. SAY laws can streamline the flow of bicycle traffic, allowing bicyclists to maintain momentum, making their movements more predictable to drivers, thereby reducing the likelihood of collisions. This momentum also improves bicyclists' maneuverability and helps bicyclists to clear intersections more quickly, reducing the overall exposure time that they are at risk of collision. They also allow bicyclists to take advantage of smaller gaps in traffic to move through intersections, which can reduce congestion and conflict points with motor vehicles.

The study found little evidence that SAY laws reduce the severity of intersection-related crashes. Despite the potential for SAY laws to reduce the number of crashes, they might not affect the severity of crashes that do occur. The severity of injuries sustained in a crash depends more on factors like the speed at which the crash occurs, the types of vehicles involved, whether the bicyclist was wearing protective gear, and the nature of the crash (e.g., whether it's a head-on collision, a side swipe, etc.) such as whether a bicyclist was making a full stop or a rolling stop. So, while SAY laws might reduce the total number of crashes, they don't necessarily change the conditions of the crashes.

One concern raised by critics of SAY laws is the potential promotion of reckless bicycling behavior. This analysis did not identify any notable changes in behaviors relative to the enactment of SAY laws. This suggests that SAY laws do not significantly influence reckless bicycling behavior or encourage bicyclists to engage in more rolling stops without fully yielding to vehicles. It is important to acknowledge that the data on behavioral factors contributing to crashes may have limitations, as they were subject to law enforcement discretion and not consistently available across all sites. Further research that directly assesses bicyclist behavior, attitudes, and perceptions regarding SAY laws could provide a more comprehensive understanding of their impact on bicycling behavior.

Prior research suggests that SAY laws have the potential to positively influence bicycling volumes. By providing a legal framework that allows bicyclists to move more efficiently through intersections, SAY laws may encourage more people to choose bicycling as a mode of transportation. This aligns with one of the arguments in favor of SAY laws, which posits that formalizing these behaviors could promote bicycling and its associated health and environmental benefits. However, the study did not directly assess changes in bicycling volumes before and after the enactment of SAY laws. A comprehensive analysis of bicycling volumes in conjunction with crash rates and other safety indicators could provide valuable insights into the overall impact of SAY laws on bicycling behavior and road safety.

Limitations

The study did have some limitations. For example, the study focused on a relatively short post-law observation period, 24 months. The availability of data elements also varied across the sites, potentially limiting certain secondary analyses and the completeness of the dataset. The study did not account for other external factors that may have influenced bicyclist safety during the study period, such as changes in infrastructure, weather conditions, or public awareness campaigns. The study's findings are based on specific MSAs and may not be fully generalizable to all geographic regions with different traffic patterns and road infrastructures. The study explored some driver and bicyclist behaviors contributing to crashes, but these data elements were not consistently available and subject to law enforcement subjectivity. While the study identified associations between SAY laws and crash rates, establishing a direct causal relationship requires further research with controlled experimental designs. The study's analysis of socioeconomic factors in relation to crash locations was limited to selected metrics and may not fully capture the complexity of interactions between these factors and bicyclist safety. The KABCO scale data is an estimate recorded from information at the scene and, particularly in the “ABC” range, may not accurately capture injury severity. Addressing these limitations and conducting further research could enhance the understanding of the impact of SAY laws on bicyclist safety.

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Conclusions

In conclusion, the empirical analysis of SAY laws at various intersections has provided valuable insights into their impacts on bicyclist safety and behaviors. Results suggest that SAY laws have the potential to reduce bicycle crashes, particularly at suburban stop-controlled intersections and urban signal-controlled intersections. The observed decrease in monthly crash rates is a promising indicator of the positive effect of SAY laws on road safety for bicyclists. Despite a reduction in crash rates, SAY laws were not associated with reductions in injury severity.

The analysis did not find significant evidence of SAY laws promoting reckless bicycling behavior. However, further research into bicyclist attitudes and behaviors, as well as enforcement practices, could provide a more comprehensive understanding of the impact of SAY laws on bicyclist behavior.

SAY laws may positively influence bicycling volumes by providing a clear set of expectations for users that encourages more efficient movement through intersections. This aligns with the potential benefits of SAY laws in promoting bicycling.

Overall, the findings provide evidence supporting the implementation of SAY laws as a potential means to improve bicyclist safety at intersections. However, a comprehensive approach that considers local traffic conditions, infrastructure, and community engagement is essential for successful implementation and ongoing evaluation of SAY laws. Effective road safety policies must prioritize the safety and well-being of all road users while promoting sustainable and healthy transportation options.

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