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Bicycle Safety and Choice: Compounded Public Cobenefits of the Idaho Law Relaxing Stop Requirements for Cycling

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ABSTRACT

Traffic safety and other policy goals are best served by relaxing stopping rules for bicyclists, legalizing existing behavior. Cyclists have been lumped with motorists under the law, yet warrants have never been made for bicyclists to determine whether their stopping is necessary or even beneficial.

Stop signs are ubiquitous, though oft "unwarranted," urban traffic calming on streets most likely to be chosen for bicycle routes. Yet stopping discourages bicycling, substantially increasing time, energy expenditure, discomfort, risk of collisions and risk for strain and overuse injuries. Removing stops may halve injury-risk by “Safety in Numbers” alone.

Intersections are the most dangerous zone for cyclists, whose safety benefits from the freedom to choose the safest time to clear, and to do so more quickly. Bicyclists enjoy vastly superior abilities to perceive and execute a safe yield at a stop than other modes, and great incentive to do so safely. Exposure to harmful pollutants which accrue at intersections is also reduced.

Idaho presents a natural experiment to test the safety of relaxing requirements due to its state law allowing cyclists to yield rather than come to a hard stop. Comparison cities lacking the law were sought and Idaho fared best for overall bicycle safety, 30.4% better than the closest match. Bicycle injuries declined 14.5% the year after adoption of the law. Interviews and a survey were conducted and all indications were that the law has been beneficial or had no negative effect, encouraging additional states to follow. Engineering options are also identified.

INTRODUCTION

Few if any topics are more controversial than stop signs in the world of traffic control. The pandemic overuse of unwarranted stop signs as traffic control has overtaken the residential streetscape, with even large agencies capitulating to the demands of residents who perceive stop signs as a traffic calming, volume reduction, and safety measure. “Like many agencies, LADOT had developed a practice of ‘giving in’ under political pressure” *(1)*.

Agencies capitulate despite ample evidence that stop signs create substantial harm, and may well create more harm than good. Despite residents’ “feeling” of increased safety and potentially reduced through-traffic volumes *(2)*. unwarranted stops have been repeatedly found to increase: urban air and noise pollution; operating costs and fuel consumption; civic liability; speeding; and frustration, leading to pervasive noncompliance *(3)*.

Costly signals increase delays while increasing speed and risk of fatality, fostering similar debate as to their efficacy and necessity.

Overuse of Controls

The overuse of controls has lead to new thinking, such as the rapidly developing field of “Shared Space.” Whereas the long march to today’s traffic control regime, and its attendant bible, the Manual of Uniform Traffic Control Devices (MUTCD), has relied on the principle of *safety through uniformity* and thus predictability, the goal of Shared Space is to remove all or nearly all traffic controls, relying instead on *safety through uncertainty*. Shared space hopes to not only protect our bodies through demonstrably fewer injuries and reduced pollution, but to unclutter the mental environment, allowing us to focus on the people and place rather than a maze-like bombardment of directorial decrees. Case studies show destinations are reached more quickly despite reduced travel speeds. Shared space has been seriously proposed in Langley, WA *(4)*, with a current proposal in Berkeley, CA.

Thus a revolution in traffic control is under way, asking that we rethink our practices and protocols.

The Unstoppable Bicycle?

While rethinking the use of stop signs is warranted from any perspective, arguably no mode has lost more to them than bicycling. Bicycling has simply been bundled with driving under the law, demanding unnecessary stops as a side effect of traffic calming for motor vehicles.

Unwarranted signals also often result from citizen pressures regarding safety concerns. Sought by many pedestrian and bicycle safety advocates for their ability to part the traffic waters, ironically, signals impose a variety of safety hazards to walking and bicycling. Along with increased delays and thus increased noncompliance, signals increase volumes and speeding, thus increasing risk and severity. Noncompliance has increased collision rates. In contrast, successful removal of unwarranted signals reportedly made a street “calmer, now that motorists are no longer speeding up the ‘green’” *(5)*.

As a result, bicyclists and *potential bicyclists* have seen their preferred routes lined with arbitrary delays, causing widespread frustration and noncompliance, increased risk for certain types of crashes and overuse injuries, and a substantial reduction in the total amount of bicycling. A hostile public perception has developed, scorning bicyclists as reckless and uncaring scofflaws, creating harmful political consequences, enforcement “stings,” and vigilante violence.

Yet warrants for bicycling have never been developed to justify this legal broadstroke.

Idaho’s Legislative Solution

In 1982, by recommendation of the Idaho legislature’s Bicycle Committee, with the approval of the State Superintendent of Public Instruction, a law was passed allowing bicyclists to treat stop signs and traffic signals as yield signs. (In 2005, the law was amended to restrict that signals be treated as stop signs, except that right turns on red remained a yield.) Thus for over 27 years, a natural experiment has transpired, allowing the transportation world a window into what life would be like were the "Idaho Law" enacted elsewhere.

This study conducts such an inquiry, adopting the initial hypothesis that there would be no measurable difference; instead, Idaho bicyclists appear to be much safer than those in other places. This study discusses likely explanations for that finding and other expected benefits.

Right of Way Rules Stable

There is no change to the right of way rules as a result of the Idaho Law. The law clearly specifies that "a person operating a bicycle or human-powered vehicle approaching a stop sign shall slow down and, if required for safety, stop before entering the intersection." The law further specifies, "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."

Traffic Signals and the Idaho Law

To a bicyclist, red lights are functionally the same as stop signs in many instances. In dense urban neighborhoods, signal spacing is similar to signs, often one per block. Suburbs contrast: signals spacing is longer,and intersections larger, with more lanes, higher speeds, and greater volumes of traffic, whereas stop signs are typically used for two lanes. Thus there are more considerations determining if it is safe to cross, but the principle of the Idaho Law – that bicyclists are uniquely able to choose their own most safe crossing times – remains in effect.

The Idaho Law originally allowed bicyclists to treat stop signs and signals identically, and no safety issue was identified. In 2005 the signal rules in Idaho were modified, such that bicyclists may still choose to yield if turning right, but must come to a hard stop before proceeding. However, bicyclists are allowed to proceed through the red after that stop.

SAFETY EFFECTS OF THE IDAHO LAW

Because Idaho provides a natural experiment, this study sought to find evidence of the safety effects of the Idaho Law.

Before and After: No Harm in Adoption of the Idaho Law

A longitudinal study of injury and fatality rates in Idaho was sought, to examine any change before and after adoption of the law in 1982, controlling for historical trends. Interviews in Idaho were conducted with authorities including police, legislators, transportation professionals, bicycle leaders of both recreational and advocacy groups, individuals involved with the original adoption of the law, and members of the general public. In summary these inquiries strongly supported adoption of the Idaho Law, and no entity whatsoever identified any negative safety result associated with passage of the law. (In February 2008, Idaho's own state Bicycle and Pedestrian Coordinator, Mark McNeese, developed an official form letter to that effect directed to any initial inquiry.)

Idaho's Office of Highway and Traffic Safety (OHS) were contacted in summer 2008 and were highly cooperative with the study; the OHS opened their historical data and allocated staff time to assist in this effort. Microfilm archives of police incident reports from 1966 to 1992 were consulted over a period of days, and deemed too difficult to analyze; archival copies of statewide yearly summaries of traffic injuries and fatalities, including summaries of fatalities and injuries by county and by mode, were located instead as best available data.

There is no evidence of any long-term increase in injury or fatality rates as a result of the adoption of the original Idaho Law in 1982. The *State of Idaho Highway Safety Plan, Fiscal Years 1981-1984*, which encompasses the period before and after the law was passed and implemented, stated that the injury rate for bicycles was constant overall and that "there is no evidence that [bicycle] fatality rates differ from the national level."

Moreover, in the year following its introduction, bicycle injury rates in the state actually declined by a substantial 14.5% with no change in the number of bicyclist fatalities. While aggregate injury rates include numerous types of collisions, the decline in injuries is consistent with the strong indication that the law actually improves overall roadway safety.

Data for 1974-1975 showed that “Passed Stop Sign” was a contributing circumstance in only 5.4% and 4.2 % of injury/fatality collisions respectively in Ada County (Boise). These collisions were primarily, if not entirely, involving motor vehicles; there were 15, then 18 total reported bicycle injury collisions for *all causes* in those years, whereas there were 123 “Passed Stop Sign” incidents, in total.

Comparison Cities: Testing the Idaho Law

An extended search for comparison cities and towns was undertaken. Boise was chosen over smaller municipalities after consideration. Numerous cities were analyzed for comparability to Boise (contact author for details).

Methodology

The best comparison found was Sacramento, California. Also a state capitol, Sacramento is highly comparable to Boise for factors affecting bicycling rates and injury rates. Capital cities tend to have special urban design elements and certain types of traffic and activities that other cities may not. The two also match very well on precipitation patterns (rain); topography (flatness); street layout (both being capital cities with numerous one-way streets, civic buildings and parks as well as gridded single and multifamily residential districts); degree of development of a bikeways network (including bike plans and a riverside bicycle path through the city); strata of populations of special risk (children under 15 and college students); overall population and worker population; recreational and advocacy organizations; and more.

California SWITRS data was compared with Idaho’s OHS data to assess total injuries. Injury data from Idaho was more detailed than that available from California’s SWITRS reports. California reports raw numbers of injuries and fatalities, whereas Idaho’s DOT provides a fairly detailed spreadsheet including the severity of the injury on the KABCO scale, where K=FATAL, A=SERIOUS/INCAPACITATING, B=VISIBLE/NON-INCAPACITATING, C=POSSIBLE/NOT VISIBLE/COMPLAINT, O=NO INJURY (PROPERTY DAMAGE ONLY). The California Highway Patrol was unable to declare which KABCO categories would count as “injury” in SWITRS data. Two sums were generated reflecting the high and low case.

Results

Idaho shown brightly as safer than Sacramento, with no fatalities year after year compared to regular fatalities in Sacramento, and a much more favorable injury rate year after year. Utilizing U.S. Census 2000 data, the best available indicator of bicycling rates, an injury-to-bicycle-commuter ratio was generated, with Boise found to be 30.4%-60.6% safer than Sacramento.

Bakersfield, CA was another comparison city, less dense, with similar in workforce size, but only 1/3 as many bicycle to work. Age strata may balance; although a higher percent are under 15 years (33% more), fewer are in college (50% less). Boise was 150%-252% safer (2.05-2.52 times safer).

Strikingly, both cities have regular fatalities each year; Boise typically has none. Data for Boise was analyzed over several years, 1999-2003, with similar results each year.

The primary difference identified between the cities was the Idaho Law. To attribute Boise's enhanced safety to the law alone would be premature without further analysis, but it is important to emphasize that this study found support in every other inquiry. Boise was safer in every comparison.

Considerations

In Idaho injury data, severity is a “crash level element,” meaning that it reports only the worst incident injury; an attempt was made to identify any case where a motor vehicle driver was more injured than a bicyclist, as that could reduce the injury count. OHS staff believed this is rare, as would common sense, but again bias was against the Idaho Law, possibly over-reporting.

Sacramento is bordered by other cities unlike Boise and Bakersfield. Boise has higher elevation (2800 ft, 854 m), above the others (400, 200 ft. – 122, 61m – respectively). Bakersfield is weak on bicycle advocacy.

Unknowns exist. The culture of drivers and traffic patterns may differ. Reporting practices may differ, both with police and the public. Sacramento has higher crime rates than Boise, and is 43% more dense, but little is known about how those factors affect non-commute bicycling, although only weak effects were found for related indicators *(6)*.

Additional Inquiries in Boise

While stationed in Boise, a series of experimental observations were conducted. Video was taken of various intersection types for later comparison with video from comparison cities. An intercept survey was completed (n=100) for the same purpose. This material has not been fully utilized. (Contact author.)

UNWARRANTED STOPS DETER AND INJURE BICYCLING

Bicycle Route Impairment

Preferred routes for bicyclists are typically quiet residential streets which connect destinations but avoid heavy traffic. These same routes are ideal for cut-through motor traffic; thus the best bicycle routes are likely dominated by four-way stops which deter bicycling.

Blocking Bicycle Boulevards

An entire class of bikeway, the Bicycle Boulevard, was thus created with the explicit goal of "reducing the number of times that a cyclist must stop along the route, and improving the ability to cross major intersections." *(7)* Bicyclists also requested an Idaho Law. *(8)*

In practice, removing stops can be politically impossible. Berkeley lead the nation with its planned citywide network, yet a decade later has failed to implement them. Traffic circles were championed by bicycle advocates for stops removal on Boulevards; instead, bicycle funds were appropriated, placing circles in other areas as traffic calming, with stop signs retained. Several new stop signs and a signal were instead placed along the boulevards, the signal introducing considerable delays while generating increased motor traffic, all in violation of policy.

Energy and Time Costs

Mandatory stopping result in a great deal of wasted energy and time – UC Berkeley physicist Joel Fajans calculated one spends five times the energy to maintain speed with frequent stops, an unattainable effort; thus "bicyclists on roads with stops signs must slow dramatically," multiplying travel times. *(9)*

Stops Hurt Bicyclists and Bicycling: Safety in Numbers, Pollution, and Shifting to Arterials

Beyond noncompliance is nonparticipation. Stops discourage cyclists from using bicycle routes, thus (a) overall bicycling declines, and (b) some bicyclists switch to arterials where dangers are greater.

In a recent Texas-based study, a route preference survey found avoiding frequent stops was of great import, second only to avoiding "heavy traffic." Avoiding "high speed limits" was third and far above the rest of the 19 categories *(10)*. In another study, Rietveld found 0.3 fewer stops per km along a route meant a 4.9% higher share of bicycling *(11)*.

Safety in Numbers

Jacobsen's landmark study, *Safety in Numbers,* found reported injuries inversely proportional to the 0.4 power of the amount of walking or bicycling, "consistent across geographic areas, from specific intersections to cities and countries" *(12)*.

Quantifying Injury Risk Generation by Stops

Given the above, an urban bicycle route impaired by stops at each intersection (assuming 20 stops per mile, 12.4/km) is expected have less bicycling than one that affords free-flow. If no alternate route exists;

if all routes have numerous stops, then the impact could be very substantial. Using Jacobsen's finding with Rietveld's, a free-flow route adds 164%, for 2.64 times more cycling, when reducing stops frequency to 2.4 stops/km (3.84/mi) rather than 12.4. Applying Jacobsen's finding, such a cycling increase is expected to improve the relative risk per cyclist to 0.55 times the previous risk, nearly halving each cyclist's risk of injury. Detailed research done by Elvik can produce more accurate case-by-case calculations *(13)*.

That large increases in bicycling result in greatly reduced risk has been seen around the globe. City after city boasts large increases in bicycling with major reductions in serious injuries *(14)*. In Portland, injury rates declined precipitously, with absolute injuries holding essentially constant while bicycling levels, inferred from bridge counts, quintupled 1991-2007. *(15)*

Thus ubiquitous stops produce real injuries simply by discouraging bicycling.

Pollution

Noise and air pollution are typically highest at intersections due to combining traffic flows, and accelerations. Allowing cyclists to clear intersections faster reduces those harmful exposures. Bicyclists are at higher risk for exposure to air pollution than the motorists that produce it found a landmark recent study, advising "any measure that increases the distance between cyclists and tail-pipes will help to reduce exposure" *(16)*. Moving to a lighter-traffic street significantly reduces exposure *(17)*. A study in Rome found higher concentrations of certain metals near signals, predicting "stop-and-go" conditions would also affect their presence *(18)*.

Switching to Arterials

When viable bike routes do not exist, cyclists, like motorists, are more likely to choose arterials for efficient travel, increasing their exposure to traffic dangers and pollution, therefore increasing their risk. Thus stop signs can push cyclists off cycle routes and increase myriad health harms.

Collision Avoidance

The dynamic nature of intersections may not redact to safer conditions when ordered rules are imposed. Bicyclists see and hear well, but are often not seen and rarely heard. Thus cyclists behave defensively, relying on their own senses and not those of others, choosing intersection traversals minimizing risk – as opposed to waiting in queue, relying on others' perception for their safety.

Most cyclists learn to survive by experience, given endemic lack of formal training, and quickly learn of negotiation's detriments. For example, a study found that "arm signals, as well as informal signals in which drivers and bicyclists make eye contact, slow down drivers' decision-making processes and lead to a decreased probability of their stopping in time when the bicyclist is at risk." *(19)* The very human form of bicyclists was shown to cause processing delays for motorists, who focus on cyclists' faces first and may erroneously assume eye contact is confirmation to proceed.

"Encountering a bicyclist is a fundamentally social interaction;" "driver attentional bias…may help explain slow driver decision responses to bicyclists seen in previous studies." *(20)*
Conflicts and risk are highest at intersections, and driver behavior is erratic. Thus the incentive exists to slip through when safe, without risky and unreliable human interaction.

Cyclists complying with stop signs complain of driver confusion about right of way, wherein motorists either disregard their right – increasing the risk of ride-out collisions – or concede right of way improperly, urging the cyclist to go, creating awkward delays and additional ride-out risks. Indeed, motorist rideout was about 60% more likely than bicyclists to cause bicycle injury crashes at stops in one study *(21)*.

Compliant cyclists also complain of motorist frustration and anger due to delays from stopping. Some cyclists have been struck from behind by motorists who assumed the bicyclist would not stop. Allowing cyclists to pass beyond first limit lines into crosswalks creates an informal bike box which reduces risk of conflict or collision from behind.

At signals, the theory of the bike box, allowing bicyclists to be out in front of traffic and thus more visible, with a head start, is very much a response to this problem.

Compliance Kills

Trucks in particular pose a severe danger to bicyclists, particularly those who obey the law! Women in London were over thrice as likely to be killed by trucks than men despite comprising only a quarter of cyclists there *(22)*. A 2007 report by Transport for London found a similar disparity over 1999-2004, concluding women appeared more at risk "because they are less likely than men to disobey red lights" *(23)*.

Predictability Reduces Risk

Normalizing stops-as-yields improves predictability and thus safety.

A large study of almost 4,600 bicyclists compared Gainesville, FL, with Austin, TX. Despite much higher rates of noncompliance at stop signs and red lights, Gainesville appeared roughly 2.3 times safer from ride-out injury than those in Austin, TX where compliance is higher. The researchers observed: "**In Gainesville…many bicyclists ran stop signs, but … motor vehicles had adapted to this behavior and crash risk was minimal,**" *(21)*

Injurious Falls at Stops

Stopping can cause falls. Use of cleats, affixing shoes to pedals for mechanical efficiency, increases injury risk whenever putting a foot down, exacerbated by hard stopping. One large sports study (n=1638) found 28% of acute injuries involved "difficulty stopping or starting a bicycle or going too slow to maintain balance, including inability to detach from toe clips." *(24)*

Overuse Injuries

Repeated stopping increases risk of injury from repetitive stress. The act of a hard stop, and the subsequent resuming of speed from a hard stop, involves considerable strain on joints, particularly the wrists and knees but also the shoulders, elbows, neck and low back. (cite) The wrist suffers strain under vibration, flexion and torsion during hard stops.

Cycling can lead to a variety of overuse conditions including "cyclist palsy" and Carpal Tunnel Syndrome *(25)*, ulnar neuropathy *(26, 27)*, and other related injuries *(28-30)*, a primary treatment being, take "a holiday from bike riding" *(28)*. It is well established that vibration and strain are occupational risk factors for carpal tunnel syndrome and other repetitive stress injuries; thus strain and vibration of repeated stopping exacerbates risk for such conditions among cyclists. This author experienced symptoms caused by total compliance with stop signs. Improper fit can also increase the risk of injury. *(31)*

Criminal Antagonism: Cultural Deterrents

Research increasingly finds that bicycling declines in the absence of a supportive culture. Unwarranted stops thus contribute to social rejection and stereotypes. For instance, one study found that non-bicyclists were significantly less likely to consider bicyclists to be "responsible," with stopping considered responsible *(32)*.

Bicycle advocates' number one political backlash is stops compliance. Police have conducted "stings" to compel unwarranted behavior even in Berkeley and Portland. Vigilante behavior has even lead to fist fights *(33)* and a dangerous cut-line trap being set (cite). Criminalizing healthy behavior damages bicycling's social support.

As a result of unwarranted stopping laws, a hostile sociopolitical environment discourages bicycling; public perception of bicyclists is marred, and the likelihood of police bias is increased. For the law to be on bicyclists' side, the laws themselves must be on the bicyclists' side.

To generate a culture of bicycling requires favorable conditions. To increase bicycling, the harsh incompatibilities which have accrued in the pursuit of motorized mobility must be tempered and transformed. Even the opportunity for "pausability" – opportunistic, pleasurable, urban interactions – is diminished when stops-fatigue besets bicyclists *(34)*.

BENEFITS

In contrast to the foregoing spectrum of harms, reducing stops increases cycling, allowing more people to meet daily activity goals *(35)*. Increased cycling imbues health and social benefits, freedom from fossil fuels and freedom from driving, reducing air and noise pollution including carbon emissions. On a mass scale, those benefits can be enormous.

RETHINKING THE WARRANTS

Warranted, Dead or Alive

Warrants, like Levels of Service, were developed to facilitate motoring, not bicycling, to the detriment of the gentler modes, and must be remade if we are to adopt bicycling.

Signals lacking consideration for vulnerable modes have particularly egregious impacts beyond those already mentioned, exposing the inadequacy of existing warrants. For instance, it has been long known that right turns on red can double injuries for bicyclists and pedestrians. "This is due to the fact that many drivers do not come to a stop before turning right on red" *(36)*. Cyclists are also injured or killed because the "current state of the practice for traffic signal timing does not account for bicyclists in determining the minimum green times or clearance intervals" *(37)*.

Bicycling: the Ultimate Hybrid

Bicycling is a hybrid between walking and driving. Stop signs were created for motor vehicle control, and then applied without due consideration to bicycling. Although laws vary by state, typically pedestrians are not required to stop at stop signs, instead enjoying right of way, with pedestrians including inline skaters, motorized wheelchairs, riders of push scooters, skateboarders, and "Segway" devices, all of which can be operated at a high rate of speed and in general, are more difficult to maneuver and stop than bicycles. Why, then, would the bicycle, which falls squarely in the middle on this continuum, with superior collision avoidance, not be given the middle-ground of yielding?

The ludicrousness of requiring bicyclists to come to a hard stop is easily illustrated; a cyclist may defeat a red light by carrying the bicycle a short distance, repositioning it, and proceeding with cross-traffic, making a left turn. Similarly a bicyclist may jump off the bicycle and run across a limit line, then remount.

Collision Avoidance Abilities Compared

Bicyclists roll through a stop controlled intersection in continual awareness using many senses, unlike most motorists who rush up, peer through a peephole from a crouch, and rush on, stopping only if deemed necessary. Numerous factors need inform generation of stop sign and signal warrants for bicyclists.

Vision

The MUTCD's present Warrants approach oft discusses visibility, but does not discuss and differentiate warrants by the difference between available vision by mode. A driver has truncated vision, typically less than 50% of the frontal field of a bicyclist, positioned near waist level; bicyclists are heads above passenger cars and often taller than SUV drivers. They do not suffer from compartment glare, nor diminished vision from tinted screens. Thus they can see over more parked cars, and more clearly, detecting finer grain of movement and anticipate hazards more effectively. (Discuss using vehicle as shield.)

Hearing

An able-bodied bicyclist enjoys 3D hearing, giving a spatial sense of surrounding traffic. The present Warrants approach does not consider hearing, though it is a primary sense for bicyclists, considerably moreso than for drivers. Because bicyclists must ride defensively, sound, as well as vibration and air pressure from vehicles, are important safety senses.

This importance is evidenced by the recent attention to the quietness of electric vehicles, which have posed a new danger to the more vulnerable modes (cite).

Clearing the Danger Zone: Speed and Maneuverability

As discussed elsewhere, bicyclists rely on their momentum to find windows of opportunity, traversing intersections more quickly at times of minimum risk. Momentum affords a bicyclist myriad options to maneuver so as to avoid danger. Lack of momentum means being a "sitting duck."

Riding Defensively

The incentive to avoid collision is much higher for the more vulnerable modes, who are harder to see, and lack the physical protection drivers enjoy, changing the tolerances necessary to compel their safe behavior.

Bicyclists have the most to lose in any crash, and they face a great deal of dangerous and noncompliant activity on the roadway that threatens them. There is a difference between the traffic laws and the "laws of traffic." Bicyclists need to constantly modify behavior to accommodate and evade the unpredictable and deadly behaviors of motor vehicles and ill-suited infrastructure. Some advocates argue that the traffic laws and transportation infrastructure were not created with their safety, comfort or convenience in mind, but developed in the narrow pursuit of efficient flows of motor vehicles; that cyclists have been literally pushed off the road; that cyclists subsidize and suffer for a dominant, car-first system. Thus it makes sense that there would be widespread noncompliance with a system that hasn't respected their right to travel, let alone their right to life and limb.

Stopping Distance

A bicyclist can stop in a very short distance. (Compare to cars, inline skates; cite study.)

Turning Radius

Bicycles are able to turn in a circle so tight it would fit in the front half of a car.

Width (Squeeze)

Bicycles in operation are typically only slightly wider than a person, and may bank, allowing enhanced collision avoidance.

Decision Time and Space -- Window of Decision

Bicyclists typically approach an intersection at a reduced speed whether or not it has stop controls. The speed at which they pass over limit lines may be greater on average than that of motorists, but motorists typically approach and leave more quickly. An analysis of the time and space used for decision should show bicyclists spend more consideration on average assessing safety than motorists do.

Compliance: Proportional to Public Perception

The public votes with their behavior in the face of unreasonable restrictions.
Compliance at stop signs is thus very low for all vehicles, but generally lowest for bicyclists; for example, a study on a college campus found an overall compliance rate for stop signs of 12% when no pedestrians present, with motorcyclists never stopping, and bicyclists essentially never stopping (0.3%). *(2)*

Indeed, public pressures have set the legislative agenda for motoring just as for unwarranted stop sign placement. Speed limits have increased by up to 63% (from 55 MPH to 90 MPH) since the energy crisis measures of the 1970s, despite the negative implications for safety and oil conservation. Other laws have changed to capitulate to driver behavior; in California, by law, the 85^{th} percentile speed is determinative of whether a motorist can be prosecuted for violating the posted speed limit. In essence, speeders can set the speed limit. Bicyclists similarly vote through behavior with needless (unwarranted) stop signs. Yet unlike in the case of speeding, this study finds that in doing so they benefit the goals of oil conservation and public safety. As a policy question: if rules can be bent for motorists to waste oil and endanger lives, surely they can be bent for bicyclists to do the opposite.

Children and Stop Warrants:

Children need special consideration in the creation of bicycle warrants; while motor vehicles require an age of operation, and licensing, bicycling has no restriction. Children constitute a special risk category for bicycle safety, owing to their lesser experience and knowledge; unpredictable play, lesser motor control, *(38)* and lower visibility. One study found that age is a leading factor in "collision initiation;" with bicyclists 10-14 years of age possibly responsible for 87% of daylight collisions with motor vehicles, whereas over 25 years of age, "probably only 34% were responsible." *(39)* Children thus skew the perception that bicyclists are "always at fault," which encourages bias amongst law enforcement.

Laws and Children's Behavior

Studies consistently indicate that it is *education and supervision* that makes the difference with regards to children's roadway skills and behavior, independent of law. There are many legal behaviors that bicycle safety instructors steer children from for their own safety.

In Idaho, children are educated about bicycle and pedestrian safety through Safe Routes to Schools programs and other means. Children are taught to stop and look both ways at stop signs whether *walking or bicycling*, even though neither is required to by law. The effectiveness of trainings such as these appears to be very good, as evidenced by one study where 90% of children instructed to stop at stop signs did so. Children instructed to stop at stop signs *and* before entering the street from a driveway were half as likely to have suffered a recent bicycle crash, as opposed to those who hadn't been instructed.*(40)* Children given a bicycle education course retained over 90% of the lessons more than month later. *(41)*

Education matters. The Netherlands is a far safer place to bicycle than the United States; one reason is that "by age 10, all schoolchildren have received extensive education on safe walking and cycling practices…not just the traffic regulations but how to walk and cycle defensively…[which] is completely lacking in the United States." *(42)*. Education improves lifelong prospects for avoiding collision, and produces behavior more respectful of other travelers.

No harm was seen in Idaho. The issue of child safety remains one of society's care, not one of children's laws.

Special Considerations

Older cyclists (over 70) preferred signalized crossing of arterials in Denmark, and were more likely to stop and look before turning left *(43)*. Bicyclists with disabilities may also take special precautions. The Idaho law allows those choices to be made without impeding all cyclists.

ALTERNATIVES TO STOP SIGNS AND SIGNALS FOR BICYCLES

Political Prognosis

Today it is widely accepted that bicyclists should not be required to stop at all stop signs and signals. Although Idaho is the sole state in the USA to have provided a solution to the stopping problem for bicyclists today, others are expected to follow soon, with 2009 legislation attempted in Arizona, Montana, Oregon and Minnesota, and recent consideration in other states including Califorina and Virginia. Prominent bicycle civil rights attorney Bob Mionske advocates for this change. *(44)* Oregon first attempted a bill in 2003. *(45)* Prominent advocacy groups for pedestrian and bicycle interest have taken formal positions in support of these measures after due consideration. Further research is expected to better our understanding of the public benefits.

Options for Practitioners

Only total deregulation gives the scale uniformity for maximum benefits. However, alternate approaches can be employed.

Local Options: Engineering and Signage

Engineering fixes removing stops are not politically viable nor expedient at the scale needed; literally millions of stops need removing, while mitigating unintended consequences. In the absence of a new law, signage may selectively change permissions.

"Bicyclists Excepted" plaques are an experimental option. They are used in Berkeley, CA for regulatory signs, but not yet in the MUTCD. The UC Berkeley campus corrected prohibitory signage with unique top-mounted plaques stating, "Bicyclists Allowed."

Warnings Motorists and bicyclists alike are at risk for surprise at visibility-obstructed two-way stops with fast cross-traffic when four-way stops are the norm. Small plaques warn both of dangerous cross-traffic *(46)*. Cyclists' ears may miss the fastest cars if visibility barriers also block quiet (coasting) engine noise, with expectation for all-way control.

Engineers who believe by study that a deregulated stop sign poses a danger to the public have additional options:

(a) announcing the stop sign as two-way via "Cross Traffic Does Not Stop" plaque (W4-4P), of Section 2C.59 of the 2009 MUTCD can be used, or the appropriate, related plaque provided in that section;

(b) some combination of improving visibility and hearing, traffic calming (perhaps the best place for a stop sign), or other such measures, to reduce the unusual cross-traffic risk.

Signals Exception plaques are options, as are bicycle signals, bicycle-priority signal changes and bike boxes. The promising new development of the "Green Wave" greatly obviates the need for signal exceptions while improving transit speeds and reducing auto speeds. "In Copenhagen, a green wave on the arterial street Nørrebrogade facilitates 30,000 cyclists to maintain a 12 mph (19.3 km/h) speed for 2.5 kilometers…in Amsterdam, cyclists riding at a speed of 15 to 18 km/h will be able to travel without being stopped by a red signal" *(47)*.

National Options: MUTCD, UVC and Policy Incentives

While states cannot be compelled to pass their own version of the Idaho Law, adoption by the Uniform Vehicle Code, and Federal funding requirements, can lead to a sea change for the better. Federal funding can and should be contingent on proactive measures to ensure policy goals of more and safer cycling be met.

New Signage Experimental signage might prove viable for the MUTCD. In a location where, after an engineering study, it is believed unsafe to allow bicyclists to choose when to yield, a "Bicyclists Must Stop" plaque might be introduced (such a sign was observed in Missoula, Montana in 2008 at what appeared to be an unwarranted stop on a significant bicycle route). Another possibility is a small red stop sign hexagon with the image of a bicycle, positioned as a plaque below the primary stop sign.

Lacking the law, but desiring to allow selective yielding, a bicycle yield sign, small, posted below stop signs, could allow selective permeability by engineers. (Contact author for illustrations.)

Options for Local Governance

Strong leadership may remove stop signs on bicycle routes while reducing motor through-traffic.

Depending on state law, it may be possible to pass a local version of the Idaho Law. In California, charter cities such as Berkeley assert that right. Berkeley maintains traffic laws which violate state law.

Alternatively, an enforcement directive issued to local police by council decree, may define stops violations for bicyclists as a lowest possible enforcement priority.

CONCLUSION

There is no single measure as quick and cost effective for increased and safer cycling, than to relax stopping rules for bicyclists. Stop signs and signals intended to discourage motor traffic have been placed in precisely the places where bicyclists most wish to ride, often without warrant for motorists let alone bicyclists, discouraging cycling and creating widespread noncompliance with a requisite backlash.

Contrary to the assumption that frequent stopping and compliance with stop laws improves safety, the argument in favor of The Law has become one of saving lives, preventing injury, protecting the environment, and facilitating increased bicycling both culturally and physically. Alternatives to the law, and tempers to the law, exist for a measured approach by transportation professionals.

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