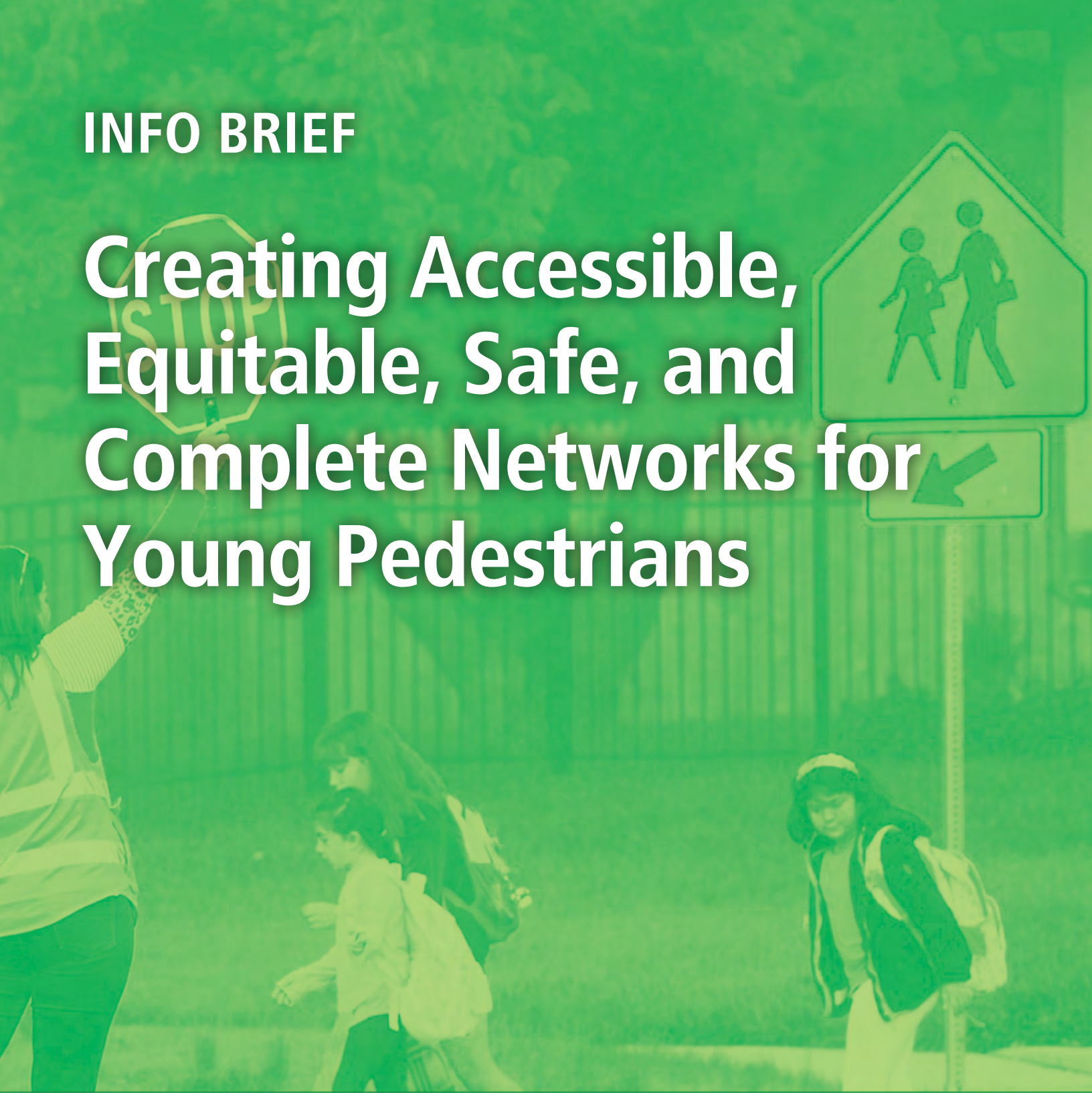
INFO BRIEF

Creating Accessible, Equitable, Safe, and Complete Networks for Young Pedestrians



Pedestrian and Bicycle Information Center
www.pedbikeinfo.org

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COVER IMAGE: Students cross the street in a marked crosswalk with the help of a school crossing guard.
Source: Caesar Rodney School District

Introduction

As communities across the United States work to eliminate pedestrian and bicyclist fatalities and serious injuries, understanding and addressing the unique needs and abilities of children and youth is critical. Children everywhere need accessible, equitable, safe, and complete networks for active travel, but in the U.S., streets and roads are not generally designed with their needs in mind. Transportation professionals need actionable ideas for how to integrate child and youth considerations into planning and projects.

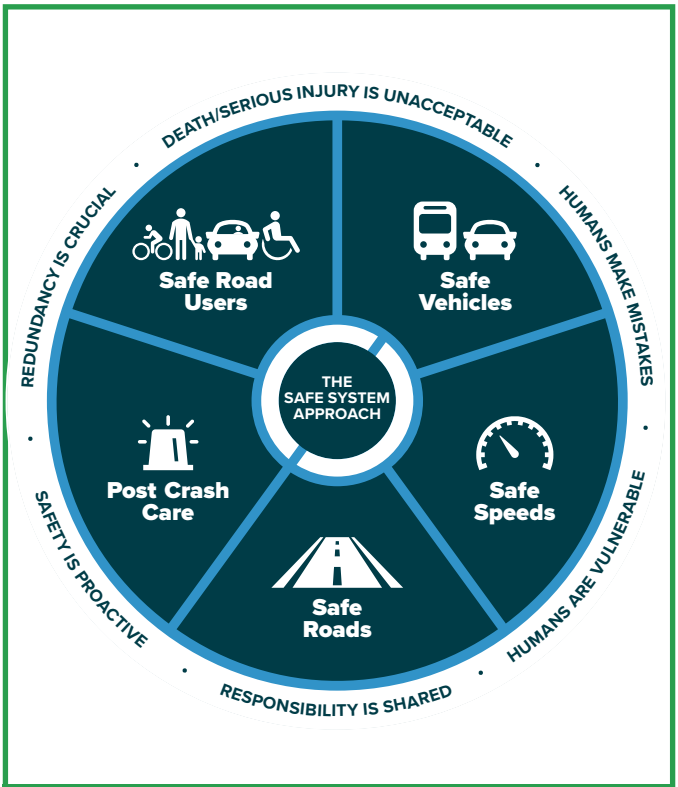
Students walk and use a wheelchair during a National Walk & Roll to School Day event. *Source: New York Mills Public School*

Planning for Child and Youth Active Travel

Considering the needs and cognitive and physical abilities of children and youth as pedestrians and bicyclists can help achieve safe transportation networks for all users, which can include on-road and off-road travel. The Safe System Approach to safety is based on six principles that encircle the graphic:

- Death/serious injury is unacceptable,
- Humans make mistakes,
- Humans are vulnerable,
- Responsibility is shared,
- Safety is proactive,
- Redundancy is crucial.

While all principles are relevant for youth, two in particular are highlighted here: humans make mistakes, and humans are vulnerable.[1] Child and youth travel looks different, as they generally walk in different places and at different times of day than adults and are less physically and cognitively mature.



Federal Highway Administration (FHWA) Safe System Approach. *Source: FHWA* [2]

Children and youth are more susceptible to mistakes.

During childhood and into their teen years, young people are building experience walking and biking and interacting with motorists. They are developing the cognitive and physical abilities that help them anticipate driver mistakes and make decisions about where to walk and cross a street. Walking near motor vehicles requires strong attention and focus skills, the ability to process information and make decisions quickly, impulse control, and the ability to handle multiple cognitive and physical tasks at once.[3,4] This development occurs at different rates among children. Furthermore, children's abilities differ from adults, making them more susceptible to their own mistakes and the mistakes of other road users. For example:

- Children are physically smaller than adults, which reduces their visual field while looking for oncoming vehicles or looking around parked vehicles, street furniture, and landscaping. Likewise, drivers are less able to see children, strollers, and/or people using wheelchairs, especially given the vantage points and blind spots of increasingly large vehicles.[5,6]
- When deciding whether it is safe to cross the street, children under age 14 have difficulty consistently judging a safe gap between a passing vehicle and an oncoming one. Once a decision is made to cross, younger children take longer to act, potentially sacrificing safety. Lack of understanding the multiple risks in an environment may also lead to challenges in identifying the safest crossing locations.[7]
- Similarly, riding a bicycle requires simultaneous execution of both motor and cognitive skills, but younger children struggle to do both and often forgo cognitive performance for motor skill performance, potentially putting themselves in unsafe situations.[8]
- Finally, while youth may have developed the cognitive ability to properly estimate timing and distance for crossing the street, they often have not accumulated the same experience as an adult. This lack of experience means they have less skills to anticipate driver errors. As they gain independence and begin to walk, bike, or take transit to new and further destinations, they may be faced with unfamiliar and more complex street environments and crossing situations.

Young teen walking in front of a truck.
Source: Nancy Pullen-Seufert

Children and youth are more vulnerable to crash forces than middle aged adults.

Due to their size, children experience more severe injuries in the event of higher speed crashes,[9,10] and their growing and developing bodies also make them more susceptible to impacts from all types of injuries.[11] A study using five years of pedestrian crash data and emergency department patient records in North Carolina revealed that older adults and children were more likely to sustain severe and fatal injuries in a crash than other age groups. Children also sustained more traumatic brain injuries than adults – 11.4 percent for children ages 0-14 compared to 8 percent for adults ages 25-64.[12] Similarly, a study of 5,000 hospitalized pedestrians in Los Angeles County revealed the most common injuries for children (beyond superficial injuries) were to the head and neck compared to musculoskeletal injuries being most common in adults.[13] Sports utility vehicles, which comprise a growing portion of vehicles on U.S. roads, pose a greater risk to children than adults.[14]

Students walk to school during a National Walk & Roll to School Day event.
Source: New York Mills Public School

Child and youth travel patterns differ from adults.

Children walk in different places and at different times of day than adults. While business centers and commercial areas are common destinations for adults, children and youth travel to school, parks and playgrounds, a friend's or relative's home, and after-school centers or sports facilities. Outside of morning travel to school, these youth trips often happen at off-peak hours,[15] especially following mid-afternoon school dismissal times.

Mobility choices are also more limited for youth, particularly for children below the age requirements for a driver's license, bikeshare, or scooter share systems, or older youth who do not drive. Younger children may be given opportunities to walk or bike to neighborhood destinations, while older youth often have more independence and may travel further distances by foot, bike, or transit to get places, including after-school jobs. Having a complete and connected multimodal network supports safety for reaching these destinations.

While helping children develop safety skills is important, educational and behavioral interventions are not enough to reduce crashes involving child pedestrians and bicyclists. The Safe System Approach recognizes that the built environment influences road users' behavior and that individual awareness alone will not prevent crashes but systemic change will. Decision makers must account for children and youth in transportation design and operations so that inevitable mistakes of adult drivers and traveling children do not result in severe injuries and fatalities.

Three Actions to Improve Planning for Child and Youth Active Travel

With the knowledge that children and youth are not just small adults — that their ability to understand and navigate traffic situations differs from adults — planners and engineers can refine approaches to transportation planning and design for these vulnerable road users. Below are three actionable ideas to improve planning for child and youth active travel.

1. Elevate the expertise of youth in all stages of planning and project development

Community engagement is valuable for any transportation plan and project, and projects that aim to benefit youth are no exception. Given the opportunity, children and youth can provide insights on the issues they face and changes that would improve their travel. Meaningful youth engagement is key — children and youth should be seen as key community members, not just photo opportunities.[16] Strategies for successful child and youth engagement include:

Meet youth where they are.

Arrange engagement activities at places where youth already gather, such as at schools, after-school programs or clubs, libraries, playgrounds or parks, community centers, sporting events or practices. For its Safe Routes to School Infrastructure Plan, the City of Austin, Texas held more than 50 events to meet children and families where they were, including at grocery stores, restaurants and taquerias, food trucks, school fall festivals, and even a Tae Kwon Do studio.[17]

Engage youth in data collection.

Children and youth can provide lived experiences that can inform professionals' ability to understand travel patterns, identify key destinations, and expose important issues they face in their travel. By working in partnership with schools or after-school programs, younger children and caregivers can participate in a street safety audit, pointing out what feels safe or comfortable and what does not, or be asked to take pictures of places that need improvements along their travel routes. Older youth can identify locations on a map where there are issues or opportunities. The map can be a physical one or use virtual tools like the Youth Engagement App,[18] WalkRollMap[19] and others. Planners can use the information to determine the areas in need of improvement, get crowd-sourced information on the issues at each location, and identify new projects.

Milwaukee Safe Routes to School student workshop.

Source: Wisconsin Bike Fed

Youth and adults working on a quick-build installation. *Source: Ulupono Initiative*

Partner with youth in project design.

When provided with resources and tools, older youth can participate in decision making on infrastructure improvements, and even quick-build project installations. A growing number of communities are engaging youth in this way. In 2019, the City and County of Honolulu Complete Streets Department constructed a quick-build project near Farrington High School and engaged young people thanks to the Ulupono Initative. The team used delineators and paint to create interim curb extensions, providing additional pedestrian space and shortening crossing distances. The project description on the Department's webpage notes that "the Farrington High School Engineering Academy students played an integral role in the project's development, working closely with the City to identify the project locations and to produce a mural design that reflected and enhanced the Kalihi neighborhood."[20] And in 2020, the Milwaukee Safe Routes to School Program held community workshops to identify priorities for infrastructure improvements around eight schools. Program staff engaged youth in the design process through cross-curricular activities, mapping the area around their school, and developing street designs.[21]

2. Gather youth-specific data

Given that child and youth travel patterns and needs are different from adults', it is important to consider how, when, why, and where children travel, and how this might be reflected — or missed — in the data routinely used to inform planning and decision making.

Travel modes.

While the National Household Travel Survey provides valuable national-level information on person trips by age and produces reports on school travel modes and travel trends for teens, local-level travel patterns require a look at U.S. Census data. However, U.S. Census data only reports on workers ages 16 and up. There are many additional options for gathering school active travel data. They range from observational counts during arrival and dismissal times, to using technological supports like websites such as www.bikewalkroll.org, travel apps such as Love to Ride to track active travel patterns and radio frequency identification (RFID) tags.

In addition to student travel modes, the Michigan Safe Routes to School program hosts an online survey for students in grades 3-12. The survey, which is designed to be administered at school, evaluates how far students live from the school, what prevents them from walking or biking, and their general attitudes about walking, biking, and safety.[22]

The Boston Youth Transportation Project, [23] supported by then-City Councilor, now Mayor Michelle Wu's Office, collected information on youth travel times to/from schools, home departure times, and attitudes toward different transportation modes. The project prioritized low-income youth and youth of color, and Boston neighborhoods underserved by transportation options. The project team distributed surveys and conducted focus groups through summer youth programs to gather information on transportation barriers for walking, biking, and taking transit. The project showed the long lengths that a significant portion of students had to travel to school and home, the implications for students with unreliable transit service, and youth barriers to biking and transit.

Crashes and crash risk.

Planning projects often include an assessment of crash history and risk. Increasingly, communities are identifying high-injury networks (HIN), corridors with the highest levels of fatal and serious crashes for pedestrians, bicyclists, and motorists. Police reports and hospital records are the two main sources of data to measure pedestrian motor vehicle crashes, including those involving children. However, under-reporting of pedestrian crashes via police reports is well-documented,[24] especially for crashes with less severe injuries,[25,26] and happens at even higher rates when children are involved.[27] Moreover, some police report records do not provide details on crash location.[28,29] If a comprehensive analysis of crashes is already part of the planning project, it may be beneficial to look at youth crashes separately or to supplement police-reported crash data with other sources of injury data, such as emergency department or trauma records.

Students arriving to school in Philadelphia, PA.
Source: National Center for Safe Routes to School

Assessing pedestrian crash risk gives an opportunity to be more proactive in preventing crashes. As a part of a Vision Zero for Youth Demonstration Project in Philadelphia, PA, the project team examined pedestrian crash data specifically for children and youth under 18 years of age over a five-year period. The analysis identified three crash types that comprised 89 percent of youth pedestrian crashes and detected roadway risk variables associated with each. The assessment also revealed that youth pedestrian injury crashes were underrepresented on the HIN compared to adult pedestrian injury crashes. Sixty-one percent of youth pedestrian injury crashes occurred outside of the city's HIN. For more information about the project, see the Vision Zero for Youth Demonstration Project, Philadelphia, PA, 2019 – 2021 summary report.[30]

3. Consider the cognitive and physical abilities of children in countermeasure selection

Multilane roads, high vehicle speeds, and high traffic volumes present increased risk for pedestrians of all ages,[31] and risk thresholds may be lower for young children. There are several national resources, best practice reports, and guidelines that provide information on road safety countermeasures to address these risks, including Federal Highway Administration (FHWA) Proven Safety Countermeasures,[32] National Association of City Transportation Officials (NACTO) Urban Street Design Guide,[33] PEDSAFE,[34] and BIKESAFE.[35] Being mindful of the differing needs and abilities of children and youth, transportation planners and engineers can apply a refined perspective when assessing and recommending pedestrian and bicycle infrastructure, particularly in areas with frequent child and youth activity, such as schools and parks.

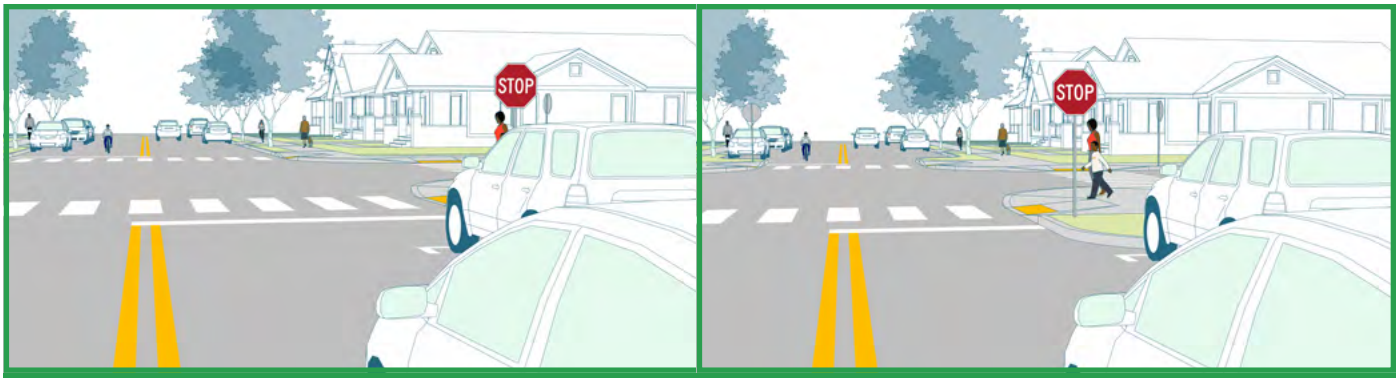
The needs of children and youth also align with countermeasures and strategies that support a Safe System Approach to transportation planning,[36] specifically those that:

1. Separate users in space.
2. Separate users in time.
3. Implement physical features to slow traffic.
4. Implement speed enforcing strategies.
5. Increase attentiveness and awareness.

Student riding on multi-use path in Stratham, New Hampshire.
Source: National Center for Safe Routes to School

Separating users in space provides a dedicated part of the right-of-way for all road users to minimize conflicts, or completely separate the right-of-way. This is especially important for children as they are developing the cognitive ability that supports walking near motor vehicles, and for older youth as they begin to navigate more complex roadways. For example:

- Sidewalks are crucial for young pedestrians. They provide a dedicated space and protected environment for children to walk and interact within their neighborhoods separate from vehicular traffic. It is important that sidewalks are wide enough to accommodate people traveling side-by-side — younger children and adults or older youths walking together — and even wider sidewalks are needed in areas where children gather, such as around schools, parks, and playgrounds. Ensure that sidewalks comply with accessibility guidelines for all users.
- Curb extensions simplify the cognitive demands on a young pedestrian by shortening crossing distance and decreasing pedestrian exposure to moving vehicles. They also slow driver turning speeds and improve visibility for both the pedestrian and driver. While vehicular parking within 30 feet of a stop sign is typically illegal, it often still happens, including during school arrival and dismissal times. Curb extensions help physically prevent parking too close to the crossing. Ensure that crossings and curb ramps have detectable warnings and comply with accessibility guidelines.
- Crossing islands further simplify street crossings by allowing pedestrians to assess and cross one direction of traffic at a time. As older youth begin to navigate more complex, multilane crossings, crossing islands provide them with a safe space to stop and assess traffic before proceeding. Crossing islands also reduce the amount of time pedestrians are exposed to oncoming traffic. Again, ensure compliance with accessibility guidelines.

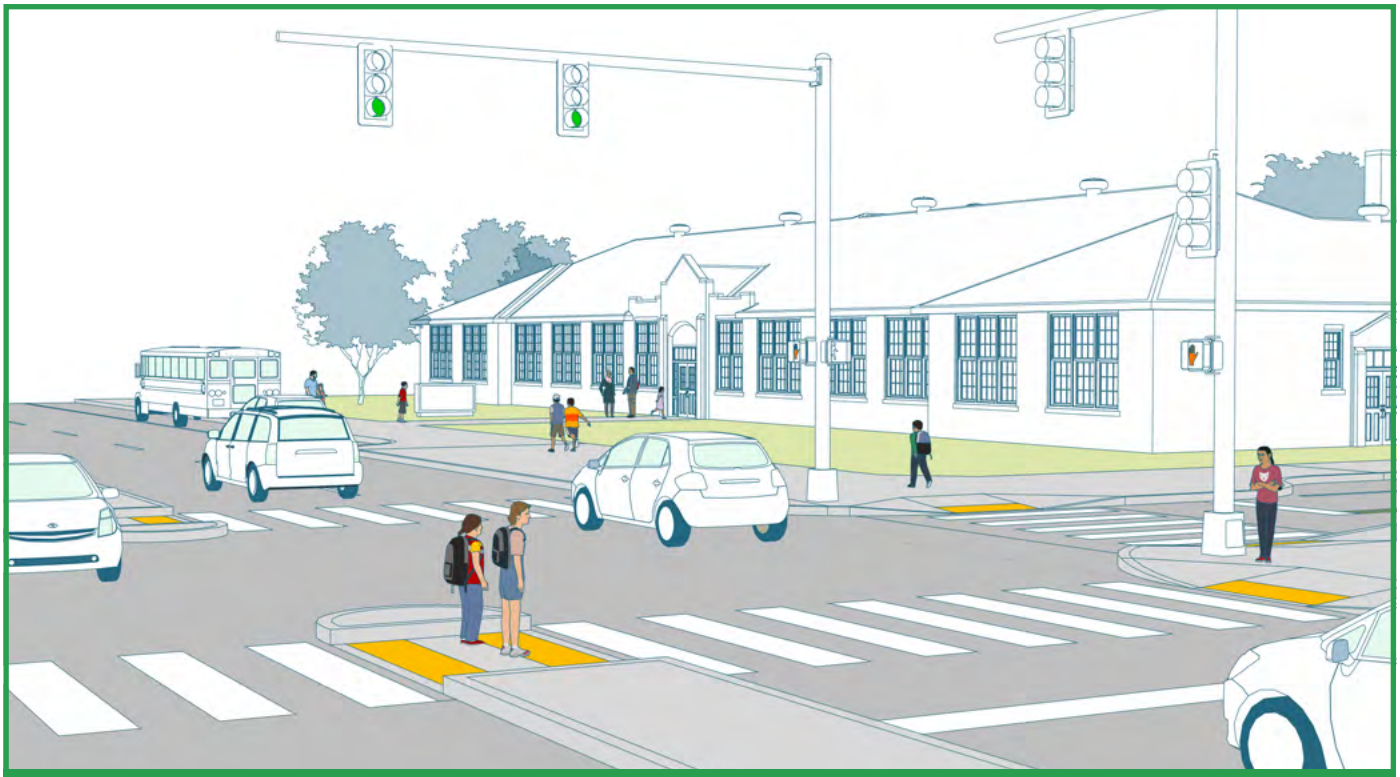


Curb extensions help increase visibility for drivers while also reducing crossing distance for children. Drawing at left shows view without curb extension. Drawing at right shows view with curb extension.

- Shared use paths and other trails provide complete separation from motor vehicles. Trails often connect to destinations that children desire, including park and recreation sites. Connector trails can link neighborhoods and avoid the need to walk along or cross busy collector and arterial highways. Where trails cross roadways at grade, the curb extensions and crossing islands also help the trail users.

Separating users in time creates a safer environment for children and youth by reducing vehicle interactions as they learn to navigate more complex roadways.

- "No turn on red" signs and protected turn phases, such as a protected left turn, restrict vehicle turning movements during pedestrian WALK phases, reducing potential conflicts, and providing young pedestrians a simplified crossing experience.



Crossing islands simplify street crossings by allowing pedestrians to assess and cross one direction of traffic at a time while also reducing the amount of time pedestrians are in the path of traffic.

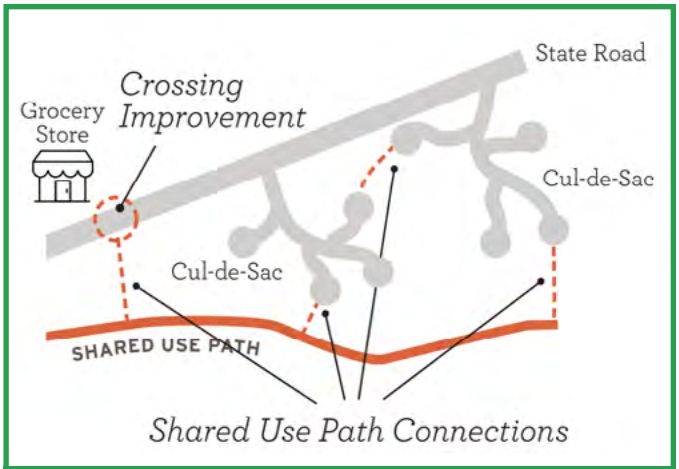


Diagram depicting shared use connections. *Source: FHWA*[37]

Implementing physical features to slow traffic can reduce both crash risk and severity for all pedestrians. Due to their vulnerability to crash force, reducing vehicle speeds is particularly important for youth. Slower vehicle speeds also reduce the time needed for a vehicle to stop, which allows drivers to be more responsive to other road users and their decisions.

- Roundabouts reduce vehicle speeds at uncontrolled intersections in residential areas where younger children tend to be more active.
- Corner radius reductions create a sharper turn for motor vehicle drivers and reduce the speed of turning vehicles at intersections. They also reduce the distance needed to cross streets.
- Road diets and lane narrowing have a proven safety benefit to overall crashes, not just pedestrian crashes. Eliminating or narrowing travel lanes slows vehicle speeds and shortens crossing distance, providing a safer environment for young pedestrians.
- Raised crosswalks provide vertical elevation that improves the visibility of pedestrians, particularly beneficial for shorter, younger children. They also slow the speeds of motor vehicles at crossings.

Implementing equitable speed enforcing strategies around schools and parks can save lives and reduce serious injuries.

- Automated speed enforcement has been shown to be effective in reducing speed and speed-related crashes, particularly in and near school zones. Evaluation of an automated speed enforcement program in Montgomery County, Maryland that focused on residential streets and school zones showed a 10 percent reduction in mean vehicle speeds, and a 62 percent reduction in the likelihood that a driver was traveling more than 10 mph over the speed limit at the camera sites.[38]

  New York City's school zone speed camera program began as a pilot at 20 locations in 2013, expanded to 140 locations in 2014, and was signed into law in 2019. As of May 2022, there are over 2,000 speed cameras operating within a quarter-mile radius of a school. The program has been successful in reducing speeding; as of December 2021, speeding at camera locations had dropped, on average, 73 percent. It has also supported the city's Vision Zero goal of eliminating traffic deaths and serious injuries. When compared to similar roads outside of the school speed zones, corridors that received cameras showed greater decreases in deaths and serious injuries.[39]
- School zones offer the opportunity to reduce the speed limits around schools and implement special enforcement strategies, such as increased fines for speeding or other traffic violations or photo radar systems.[40]

Daylighting improves visibility of pedestrians by removing parked cars next to crosswalks and opening the field of vision for all road users at intersections. Drawing on left shows view without daylighting. Drawing to right shows view with daylighting.

Increasing driver attentiveness and awareness of vulnerable road users can impact driver behavior in ways that create safer environments for young pedestrians.

- Rectangular Rapid Flashing Beacons and Pedestrian Hybrid Beacons increase driver yielding to pedestrians at uncontrolled crossings and create safer crossings for younger children still learning to identify safe gaps in traffic.
- Parking restrictions close to pedestrian crossings, or "daylighting," improves visibility of all pedestrians, but is especially important for young children who, due to their height, may not be visible to drivers or be able to see oncoming traffic over parked vehicles. Daylighting also serves as a physical deterrent to parked vehicles near the crossing, which is usually prohibited within 30 feet of a stop sign. Despite this regulation, such unauthorized parking frequently occurs, especially during school arrival and dismissal times.
- Pedestrian facility lighting not only makes it easier for drivers to see pedestrians, but it also makes it easier for pedestrians to see their surroundings and monitor vehicle movements. For youth at certain times of the year, school arrival and after-school activities may occur in low light or darkness. Pedestrian lighting would improve the safety of intersection crossings at key destinations such as schools, bus stops, and parks or recreational facilities.

Slow Streets and School Streets initiatives can also greatly benefit children and youth. Limiting motor vehicle access through time-restricted closures, full street closures, or shared spaces around schools can prioritize young walkers and bicyclists and encourage use of active travel modes.[42]

It is crucial to acknowledge that while engineering measures are valuable, young children also need to be accompanied by a responsible adult.

School Street in Seattle, WA.

Source: Seattle Department of Transportation

Conclusion

Children and youth are not just small adults. As pedestrians and bicyclists, their cognitive and physical differences make them more likely to make mistakes and more susceptible to the mistakes of others, more vulnerable to crash forces, and their travel patterns differ from adults'. Through conscientious consideration of children and youth's lived experiences, meaningful youth engagement, gathering of youth-specific data, and applying a youth-lens to infrastructure treatment selection, transportation professionals can more fully understand and more intentionally acknowledge these differences and take steps to address them, ultimately creating equitable, safe, and complete networks for youth and all road users.

Resources

- **The Safe System Approach Flyer** by the Federal Highway Administration
- **Designing Streets for Kids** by the Global Designing Cities Initiative and the National Association of City Transportation Officials
- **Engaging Youth to Advance Safer Streets for All: Guide and Inspiration for Partnership Between Youth and Adults** by the National Center for Safe Routes to School
- **Proven Safety Countermeasures** by the Federal Highway Administration
- **Urban Street Design Guide** by the National Association of City Transportation Officials (NACTO)
- **PEDSAFE Pedestrian Safety Guide and Countermeasure Selection System** by the Federal Highway Administration
- **BIKESAFE Bicycle Safety Guide and Countermeasure Selection System** by the Federal Highway Administration

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References

1 FHWA. (2023, May 8). *Zero deaths and safe system.* **https://highways.dot.gov/safety/zero-deaths**

2 Federal Highway Administration (FHWA). (n.d.) The Safe System Approach. **https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/FHWA_SafeSystem_Brochure_V9_508_200717.pdf**

3 Schwebel, D. C., Davis, A. L., & O'Neal, E. E. (2012). Child pedestrian injury: A review of behavioral risks and preventive strategies. *American Journal of Lifestyle Medicine, 6*(4), 292–302. **https://doi.org/10.1177/0885066611404876**

4 Percer, J. (2009). Child Pedestrian Safety Education: Applying Learning and Developmental Theories to Develop Safe Street-Crossing Behaviors. **https://doi.org/10.21949/1525673**

5 Voelk, T. (2020, May 21). "Rise of S.U.V.s: Leaving Cars in Their Dust, With No Signs of Slowing." New York Times,. **https://www.nytimes.com/2020/05/21/business/suv-sales-best-sellers.html**

6 Insurance Institute for Highway Safety, Highway Loss Data Institute (2023, July). Pedestrians and bicyclists, Vehicle design. **https://www.iihs.org/topics/pedestrians-and-bicyclists#vehicle-design**

7 O'Neal, E. E., Jiang, Y., Franzen, L. J., Rahimian, P., Yon, J. P., Kearney, J. K., & Plumert, J. M. (2018). Changes in perception–action tuning over long time scales: How children and adults perceive and act on dynamic affordances when crossing roads. *Journal of Experimental Psychology: Human Perception and Performance, 44*(1), 18–26. **https://doi.org/10.1037/xhp0000378**

8 Ellis, J. (2014). *Bicycle safety education for children from a developmental and learning perspective* (Report No. DOT HS 811 880). Washington, DC: National Highway Traffic Safety Administration. **https://www.nhtsa.gov/sites/nhtsa.gov/files/bicycle_safety_education_for_children-811880.pdf**

9 Amiour Y, Waygood EOD, van den Berg PEW. Objective and Perceived Traffic Safety for Children: A Systematic Literature Review of Traffic and Built Environment Characteristics Related to Safe Travel. Int J Environ Res Public Health. 2022 Feb 24;19(5):2641. doi: 10.3390/ijerph19052641. PMID: 35270325; PMCID: PMC8910047.

10 Cloutier M, Beaulieu E, Fridman L, et al. State-of-the-art review: preventing child and youth pedestrian motor vehicle collisions: critical issues and future directions. *Injury Prevention 2021*;27:77-84. **https://injuryprevention.bmj.com/content/injuryprev/27/1/77.full.pdf**

11 Peden, M., Oyegbite, K., Ozanne-Smith, J., Hyder, A. A., Branche, C., Rahman, A. K. M. F., Rivara, F., & Bartolomeos, K. (Eds.). (2008). *World report on child injury prevention.* World Health Organization. **https://www.who.int/publications/i/item/9789241563574**

12 Harmon, K. J., Hancock, K. A., Waller, A. E., & Sandt, L. S. (2020). Selected characteristics and injury patterns by age group among pedestrians treated in North Carolina emergency departments. *Traffic Injury Prevention, 21*(sup1), S157–S161. **https://doi.org/10.1080/15389588.2020.1829912**

13 Peng, R. Y., & Bongard, F. S. (1999). Pedestrian versus motor vehicle accidents: An analysis of 5,000 patients. *Journal of the American College of Surgeons, 189*(4), 343-348. **https://doi.org/10.1016/S1072-7515(99)00166-0**

14 Mickey Edwards, Daniel Leonard, Effects of large vehicles on pedestrian and pedalcyclist injury severity, *Journal of Safety Research, Volume 82*, 2022, Pages 275-282, ISSN 0022-4375, **https://idot.illinois.gov/content/dam/soi/en/web/idot/documents/transportation-system/reports/safety/itrcc/effects-of-large-vehicles-on-pedestrian-and-pedal-cyclist.pdf**

15 Global Designing Cities Initiative, National Association of City Transportation Officials (2020). *Designing streets for kids.* **https://nacto.org/publication/designing-streets-for-kids/**

16 Collard de Beaufort, A., Marchetti, L., Smith, J., & Pullen-Seufert, N. (2023). *Engaging youth to advance safer streets for all: Guide and inspiration for partnership between youth and adults.* National Center for Safe Routes to School. **https://www.visionzeroforyouth.org/wp-content/themes/VZY_Custom/pdfs/VZY_YouthEngagement_Guide.pdf**

17 City of Austin Public Works Safe Routes to School. (2019). *Citywide summary report of the 2016 Mobility Bond Council District infrastructure reports.* **https://www.austintexas.gov/sites/default/files/files/Public_Works/Child_Safety/AustinSRTSCitywideSummaryReport.pdf**

18 International Road Assessment Program (2023). *YEA -Youth engagement app* (Version 1.5.1). [Mobile app]. App Store. **https://apps.apple.com/gb/app/yea-youth-engagement-app/id1640023786**

19 WalkRollMap. **www.walkrollmap.org**

20 City and County of Honolulu. (2023). *Honolulu complete streets project archive.* **https://www.honolulu.gov/completestreets/project-archive.html**

21 Vision Zero for Youth. (2021). *Milwaukee SRTS program: Advancing kids' active travel during the COVID-19 pandemic.* **https://www.visionzeroforyouth.org/stories/milwaukee-wi-2021/**

22 Michigan Safe Routes to School. (n.d.) Surveys, **https://saferoutesmichigan.org/surveys/**

23 Michelle for Boston. (2018). *Boston Youth Transportation Project.* **https://www.michelleforboston.com/plans/boston-youth-transportation-project**

24 Harmon, K. J., Hancock, K. A., Waller, A. E., & Sandt, L. S. (2020). Selected characteristics and injury patterns by age group among pedestrians treated in North Carolina emergency departments. *Traffic Injury Prevention, 21*(sup1), S157–S161. **https://doi.org/10.1080/15389588.2020.1829912**

25 Janstrup, K. H., Kaplan, S., Hels, T., Lauritsen, J., & Prato, C. G. (2016). Understanding traffic crash under-reporting: Linking police and medical records to individual and crash characteristics. *Traffic Injury Prevention, 17*(6), 580–584. **https://doi.org/10.1080/15389588.2015.1128533**

26 Doggett, S., Ragland, D. R., & Felschundneff, G. (2018). Evaluating research on data linkage to assess underreporting of pedestrian and bicyclist injury in police crash data. *UC Berkeley: Safe Transportation Research & Education Center.* **https://escholarship.org/uc/item/0jq5h6f5**

27 Sandt, L. S., Proescholdbell, S. K., Evenson, K. R., Robinson, W. R., Rodríguez, D. A., Harmon, K. J., & Marshall, S. W. (2020). Comparative Analysis of Pedestrian Injuries using Police, Emergency Department, and Death Certificate Data Sources in North Carolina, U.S., 2007–2012. *Transportation Research Record, 2674*(9), 687–700. **https://doi.org/10.1177/0361198120931504**

28 Austin, K., Tight, M., & Kirby, H. (1977). The use of geographical information systems to enhance road safety analysis. *Transportation Planning and Technology, 20*(3), 249–266. **https://doi.org/10.1080/03081069708717592**

29 Ahmadi, M., Valinejadi, A., Goodarzi, A., Safari, A., Hemmat, M., Majdabadi, H. A., & Mohammadi, A. (2017). Geographic information system (GIS) capabilities in traffic accident information management: A qualitative approach. *Electronic Physician, 9*(6), 4533–4540. **https://doi.org/10.19082/4533**

30 Pullen-Seufert, N., & Lambert, D. (2022). *Vision zero for youth demonstration project in Philadelphia, PA, 2019 - 2021, Summary report.* Pedestrian and Bicycle Information Center. **https://www.pedbikeinfo.org/cms/downloads/PBIC_InfoBrief_VZYPhila.pdf**

31 National Academies of Sciences, Engineering, and Medicine. (2018). *Systemic pedestrian safety analysis (Project No. 17-73).* Washington, DC: The National Academies Press. **https://doi.org/10.17226/25255**

32 FHWA. (2023). *Proven safety countermeasures.* **https://highways.dot.gov/safety/proven-safety-countermeasures**

33 National Association of City Transportation Officials. (2013). *Urban street design guide.* **https://nacto.org/publication/urban-street-design-guide/**

34 FHWA. (2013). PEDSAFE. *Pedestrian safety guide and countermeasure selection system.* **http://www.pedbikesafe.org/pedsafe/**

35 FHWA. (2014). BIKESAFE. *Bicycle safety guide and countermeasure selection system.* **http://www.pedbikesafe.org/bikesafe/**

36 FHWA. (2022). Vulnerable Road User Safety Assessment Guidance. **https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-10/VRU%20Safety%20Assessment%20Guidance%20FINAL_508.pdf**

37 FHWA. (2016). *Small Town and Rural Multimodal Networks.* **https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/fhwahep17024_lg.pdf**.

38 Hu, W., & McCartt, A. T. (2016). Effects of automated speed enforcement in Montgomery County, Maryland, on vehicle speeds, public opinion, and crashes. *Traffic Injury Prevention, 17*(sup1), 53–58. **https://doi.org/10.1080/15389588.2016.1189076**

39 New York City DOT. (2022). *New York City Automated Speed Enforcement Program, 2022 Report.* **https://www.nyc.gov/html/dot/downloads/pdf/speed-camera-report.pdf**

40 FHWA. (2023). *Manual on Uniform Traffic Control Devices 11th Edition, Part 7, Section 7B.01.10.* **https://mutcd.fhwa.dot.gov/pdfs/11th_Edition/part7.pdf**

41 Aszklar, K., Lambert, D., Pullen-Seufert, N., & Goodman, D. (2020). *Re-envisioning school streets: creating more space for children and families.* Pedestrian and Bicycle Information Center. **https://www.pedbikeinfo.org/cms/downloads/2161_PBIC_InfoBrief_SchoolStreets.pdf**

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