IOWA STATE UNIVERSITY

Institute for Transportation

Sign Effectiveness Guide

Keith Knapp

Director

Iowa Local Technical Assistance Program

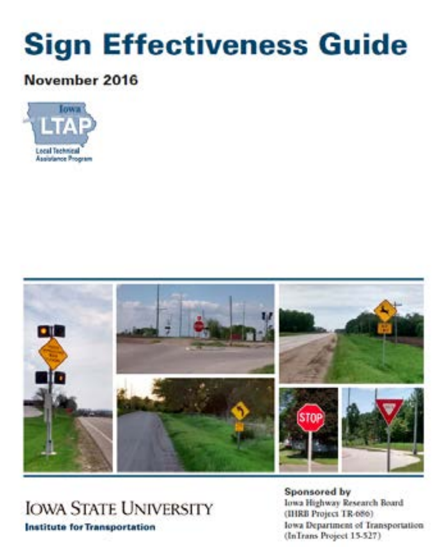
Institute for Transportation

David Veneziano

Safety Circuit Rider

Iowa Local Technical Assistance Program

Institute for Transportation



http://www.intrans.iastate.edu/research/documents/research-reports/sign_effectiveness_guide_w_cvr.pdf

Project Background

- Many signs installed and/or removed based on engineering judgment
- No existing summary of:
  - Research on sign effectiveness
  - Additional sign decision-making information (e.g., installation, removal, maintenance, etc.)
- Objective: summarize information to assist sign decision-making

Research Tasks

- Literature review and summary
- Review and summarize sign policies
- Discuss addt'l signing aspects (e.g. maintenance and management)
- Summarize Iowa law
- Review of *Iowa Traffic Control Devices Manual*

Signs Reviewed

- Stop Signs
- Yield Signs
- Speed Limit Signs
- Horizontal Alignment Warning Signs
- Playground and Children at Play Signs
- Deer Crossing Signs
- Ice Warning Signs
- Road May Flood Warning Signs
- Unsignalized Intersection Conflict Warning Systems
- Signalized Intersection Advance Warning Sign System

Impact with Context

- Confidence ratings assigned to research
  - Low, Medium and High
  - Guide reader in applying results
- Focus on applicability of results
- Consider ratings, site characteristics

Summary of Ratings

- Most studies were rated “Medium” robustness
- Medium results reliable when applied to similar sites/conditions
- No. of “High” ratings for enhanced signs indicative of more recent, focused work

		Regulatory	Warning	Enhanced
Rating	Low	2	3	6
	Medium	8	14	2
	High	1	1	6

Project Output 1/3

- 2-page summaries

Playground and Children at Play Signs

Purpose, Use, and Installation

Resident concerns related to the safety of children and others can sometimes produce requests for playground, children at play, or similar signs (see Figure 5).

MUTCD (FHWA 2012)

Figure 5. Playground sign

Requests for these signs are based on the belief that these types of signs will alert drivers to the presence of children and increase safety. It has generally been concluded with the children at play signs however, that these types of signs may only provide the perception of increased safety or a false sense of security (CTC & Associates 2007).

The installation of children at play signs is not specifically addressed in the MUTCD. However, the development and installation of a warning sign (with wording not addressed specifically) is allowed (FHWA 2012 Section 2A.06). The general understanding of the impact of these and similar signs are described below, and the MUTCD indicates that "…use of warning signs should be kept to a minimum, as the unnecessary use of warning signs tends to breed disrespect for all signs" (FHWA 2012 Section 2C.02).

The playground warning sign (Figure 5) is addressed in Section 2C.51 of the MUTCD. This section of the MUTCD indicates that the playground warning sign should be installed in advance of a designated children's playground. Therefore, the guidance on the installation of this type of sign is for a very specific location. More general information on the application of warning signs is presented in Section 2C.02 (FHWA 2012).

Safety Effectiveness

No documented studies on the attention value and crash or speed impacts of children at play warning signs were found. A synthesis of available information on this subject in 2007 was found; it generally indicated that there was no evidence (i.e. studies) that these signs were effective (CTC & Associates 2007).The published information about this sign found generally accepted engineering practice and judgment related to the effectiveness of these type of sign rather than specific safety analyses.

The installation of children at play signs is not generally supported for the reasons previously mentioned. The signs may provide only a perceived increase of safety, resulting in inappropriate

actions, and similar signs (e.g., the playground sign) have been shown to have little impact on vehicle speed (see below).The playground warning sign also has not been studied for its safety impact.

Aside from these signs, research has examined crosswalks and enhancements to them (Zegeer et al. 2005, Fitzpatrick et al. 2007). The use of crosswalks has been controversial for many years, and the two references cited here are ones that the authors consider valuable when considering crosswalks, signs, and other enhancements. Both of these documents provide guidance on application, in addition to the MUTCD, and Fitzpatrick et al. (2007) discuss crosswalk enhancements to improve safety.

Operational Effectiveness

A study at three sites found that playground warning signs produced no effect on mean vehicle speeds at one site and decreased mean vehicle speeds by 0.9 and 1.5 mph at two other sites (Davis et al. 2012). The magnitude of these vehicle speed differences, although statistically significant, is not considered significant in a practical manner.

It was concluded in this study that if this type of sign, which is installed next to locations with a playground or something similar, did not reduce vehicle speeds at any practical level, that it was likely that warning signs with a more general message (e.g., children at play) would have a similar or even less impact (Davis et al. 2012). The authors rate this study as having Medium robustness and Table A.5 of Appendix A provides additional details.

Alternatives

Some alternatives to using children at play signs could include increased speed enforcement in the area or the deployment of a temporary device, such as a portable radar-actuated speed display sign on a trailer. Similar approaches could be used as alternatives to the playground sign.

References

CTC & Associates. 2007. *Effectiveness of "Children at Play" Warning Signs.* Wisconsin Department of Transportation, Madison, WI.

Davis, G. K. Knapp, and J. Hourdos. 2012. *Vehicle Speed Impacts of Occasional Hazard (Playground) Warning Signs.* Minnesota Department of Transportation, St. Paul, MN.

FHWA. 2012. *Manual on Uniform Traffic Control Devices for Streets and Highways.* 2009 Edition with Revision Numbers 1 and 2 incorporated, dated May 2012. Federal Highway Administration, U.S. Department of Transportation, Washington, DC.

Fitzpatrick, K., S. Turner, M. Brewer, P. Carlson, B. Ullman, N. Trout, E. S. Park, J. Whitacre, N. Lalani, and D. Lord. 2007. *Improving Pedestrian Safety at Unsignalized Crossings.* TCRP Report 112/NCHRP Report 562. Transit Cooperative Research Program and National Cooperative Highway Research Program, Washington, DC.

Zegeer, C. V., J. R. Stewart, H. H. Huang, P. A. Lagerwey, J. Feaganes, and B. J. Campbell. 2005. *Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations: Final Report and Recommended Guidelines.* FHWA-HRT-04-100, Federal Highway Administration, Research, Development, and Technology, Turner-Fairbank Highway Research Center, McLean, VA.

Project Output 2/3

- Appendix tables

Appendix A. Summary Tables of Sign Studies

The tables presented in this appendix present additional study details related to the research reviewed for the different signs discussed in Chapter 2. The approach developed and applied to establish the study confidence ratings presented in the tables that follow can be found in the Results Rating System section of Chapter 2.

Table A.1. Stop sign studies

Study	Location	No. of Sites	Safety Impact(s)	Operational Impact(s)	Study Confidence
Stockton et al. 1981	NY, TX, and FL Urban and Rural	48	Conversion from yield to TWSC did not significantly reduce crashes	Field studies observed 19% voluntary stops at TWSC and AWSC sites	Medium
Souleyrette et al. 2005	IA Rural	500+	Crash rates for ultra-low volume two-way stop control not significantly different from no control Uncontrolled crash rate appears to decline versus AWSC above 150 DEV	N/A	Medium
Simpson and Hummer 2010	NC Urban and Rural	53	Conversion from TWSC to AWSC produced 68.1% crash reduction	N/A	High

TWSC - Two-way stop control, AWSC - All-way stop control, DEV - Daily entering vehicles

Table A.3. Speed limit sign studies

Study	Location	No. of Sites	Safety Impact(s)	Operational Impact(s)	Study Confidence
Solomon 1964	11 states	600 miles of rural roads	Crash rates increase as speed variability increases Crash involvement lowest at speeds slightly above average travel speeds	N/A	Low
Parker 1997	22 states Urban and Rural	100 segments 1 to 2 miles long	No evidence of crash frequency changes with raise or lowering of speed limit	Minor changes (~1.5 mph) in driver speeds with raise or lowering of speed limit	Medium
Wilmot and Jaydevan 2006	LA Rural	Statewide two-lane roads	ROTR injury, rear-end injury, ROTR PDO, rear-end PDO, and overturn PDO crash rates increased following speed limit increase	N/A	Medium

ROTR - Run off the road, PDO - Property damage only

Table A.5. Playground and children at play sign studies

Study	Location	No. of Sites	Safety Impact(s)	Operational Impact(s)	Study Confidence
Davis et al. 2012	MN Urban	3	N/A	No effect on mean speeds (one site) and decreases of 0.9-1.5 mph (two sites)	Medium

Project Output 3/3

- Additional content

Sign Removal

Souleyrette et al. developed guidelines for the removal of stop signs at ultra-low-volume unpaved roadway intersections (i.e., intersections with volumes less than 150 vpd from all directions) in rural areas (2005). The guidance provided for this process included the following four steps:

1. Develop and adopt a formal [removal] policy
2. Undertake a thorough engineering study
3. Provide appropriate public notice
4. Perform follow-up assessment

Aside from this guidance, sign removal is a topic that has not been discussed in past research or guidance documents. In general, the steps outlined above for stop sign removal, or similar steps, may be applicable to other sign removal situations. However, these steps, along with others applicable to the situation, should be considered on a case-by-case basis.

Chapter 3. Sign Program Guidance

The installation and maintenance of signs is a significant investment for any local agency. The development of a well-designed signing program is essential to the efficient and effective accomplishment of these activities. This chapter describes what the authors considered to be some of the more important characteristics and elements of a signing program. This chapter describes the following sign program components:

- Iowa county traffic sign program policies
- Approaches to sign inventories
- Retroreflectivity requirements
- Additional signing considerations such as maintenance

Iowa Sign Program Policies

Many agencies have developed and adopted sign program policies. The establishment of a formal signing policy can aid in the overall management of signs. The policy can establish procedures to identify whether there is a need for a sign and also define the processes that should be followed in making such a determination. The policy can provide direction to local agency staff with regard to the prioritization of sign installation, and the allocation of resources to accomplish this activity.

A formal signing policy can also often provide support when legal action related to signing occurs—by documenting the approach used. In fact, these types of policies should generally be developed with the input of the local agency attorney to ensure that they are comfortable with its content.

Retroreflectivity Requirements

Retroreflectivity is a critical component of roadway signage and the approach used to manage it must be documented (see MUTCD Section 2A.08). This characteristic of sign sheeting allows drivers to properly see regulatory, warning, and other signs at night by direct reflection of light from a vehicle's headlights back to the driver (i.e., sign retroreflectivity). Figure 12 shows how sign retroreflectivity works. The process of directly measuring retroreflectivity is described in the Retroreflectometer Guide in Appendix E.

Additional Signing Considerations

In addition to a focus on MUTCD retroreflectivity requirements, a number of other activities are done to properly maintain a sign. These are discussed in this section.

Cleaning

Signs may need to undergo cleaning (depending on conditions) to maintain their visibility during all times of day. A dirty sign may be legible during the day, but nearly invisible at night (i.e., no legibility or retroreflectivity). One example of this occurrence is shown in Figure 13.

David Veneziano, Iowa LTAP

Figure 13. Dirty speed limit sign during the day (left) and at night (right)

Chapter 4. Liability and Signs in Iowa

One of the tasks included in this project was to request some legal input about the liability issues connected to traffic control devices, from the perspective of a local municipality in Iowa. This task was accomplished through the Iowa State Association of Counties (ISAC). ISAC obtained an opinion through an attorney used by the Iowa Communities Assurance Pool (ICAP) and this opinion letter is included in Appendix F. The letter provides a discussion of the protections offered to the State and municipalities in Iowa by referring to the Iowa Code that applies, Section 668.10(1)(a) (Iowa Code 2015d), and stating the following:

"In its simplest interpretation, a municipality cannot be held liable for failing to place, erect or install traffic control devices, on any type of road. However, once the traffic control device has been installed, a municipality can be assigned fault if the municipality does not properly and adequately maintain the device." (Madsen 2015)

A Goal We Can All Live With

Case Study Input

- You are considering the use of curve warning signs and chevrons due to nighttime crashes.
- Will safety improve if I install these?
- Givens:
  - 8 nighttime lane departure crashes/year
  - Rural site
  - No signs now
  - ADT of 750

Case Study - Sign Table

- Review Appendix A

Table A.4. Horizontal alignment warning sign studies

Study	Location	No. of Sites	Safety Impact(s)	Operational Impact(s)	Study Confidence
Srinivasan et al. 2009	CT and WA Rural	228	Installing curve warning signs and chevrons produced: 18% reduction in injury and fatal crashes 27.5% reduction in nighttime crashes 25% reduction in night lane departure crashes	N/A	High
Lalani 1992	CA Urban	3	Chevrons produced 50% reduction in crashes	N/A	Low
Montella 2009	Italy Rural	15	Chevrons produced 2.6% crash reduction Curve warning signs and chevrons produced 40.8% crash reduction Curve warning signs, chevrons and beacons produced 47.6% crash reduction	N/A	Medium
Dixon and Avelar 2011	OR Rural	16	Curve advisory speed plaque had small positive impact on crash reduction	N/A	Medium
Peaslee 2005	CA Rural	Unknown	Curve warning sign installation produced 42.1% crash reduction	N/A	Low
Re et al. 2010	TX Rural	2	N/A	Chevrons produced 1.28 mph mean speed reduction Chevrons and reflectors produced 2.20 mph mean speed reduction	Medium
Chrysler et al. 2009	TX Rural	5	N/A	Installation of chevrons reduced mean speeds 0.17-4.08 mph	Medium
Bullough et al. 2012	NY Rural	2	N/A	Progressively larger chevrons reduced mean speeds 05.0-1.75 mph during daylight and 3.0 mph at night	Medium
Ritchie 1972	OH Rural	162	N/A	Average horizontal curve speeds exceeded posted advisory speed when advisory was less than 40 mph	Medium

Case Study - Sign Text

- Or…review 2-page summary

- The installation of curve warning signs and chevrons at 228 locations in Connecticut and Washington produced an 18 percent reduction in injury and fatal crashes, 27.5 percent reduction in nighttime crashes, and 25 percent reduction in nighttime lane-departure crashes (Srinivasan et al. 2009). The authors rate this study as having High robustness.

- The installation of chevrons produced a 50 percent reduction in crash frequency based on a simple before-and-after comparison at three study sites (Lalani 1992). The authors rate this study as having Low robustness.

- A third study also considered the installation of chevrons at 5 sites and showed a 2.6 percent reduction in total crashes; the installation of curve warning signs and chevrons at 6 sites produced a 40.8 percent reduction in total crashes; and finally, the installation of curve warning signs, chevrons, and flashing beacons at 4 sites produced 47.6 percent reduction in total crashes (Montella 2009). The authors rate this study as having Medium robustness.

- Another study was found that focused on the horizontal curve advisory speed plaque impact on crashes. It was determined that they had a positive impact on reducing crashes along two-way, two-lane rural roadways, but the impact was small in comparison to other factors such as traffic volume, horizontal curve length, etc. (Dixon and Avelar 2011). The authors rate this study as having Medium robustness.

- Mendocino County, California, achieved a 42.1 percent reduction in crashes between 1992 and 1998 by an initial installation of curve warning signs (Peaslee 2005). The authors rate this study as having Low robustness.

Case Study - Addt'l Info

- MUTCD Table 2C-5

Type of Horizontal Alignment Sign	Difference Between Speed Limit and Advisory Speed				
	5 mph	10 mph	15 mph	20 mph	25 mph or more
Turn (W1-1), Curve (W1-2), Reverse Turn (W1-3), Reverse Curve (W1-4), Winding Road (W1-5), and Combination Horizontal Alignment/Intersection (W10-1) (see Section 2C.07 to determine which sign to use)	Recommended	Required	Required	Required	Required
Advisory Speed Plaque (W13-1P)	Recommended	Required	Required	Required	Required
Chevrons (W1-8) and/or One Direction Large Arrow (W1-6)	Optional	Recommended	Required	Required	Required
Exit Speed (W13-2) and Ramp Speed (W13-3) on exit ramp	Optional	Optional	Recommended	Required	Required

Required = The sign and/or plaque shall be used
Recommended = The sign and/or plaque should be used
Optional = The sign and/or plaque may be used
See Section 2C.06 for roadways with less than 1,000 ADT

Case Study Conclusions

- Based on appendix/text information
  - High rated study available
  - Setting and crashes addressed match
  - Nighttime lane departure crashes reduced 25%
  - Expect use of curve warning/chevrons to reduce target crashes from 8 to 6
- If only medium/low studies
  - Pay attention to research site/application
  - Select study with similar characteristics

Project Conclusions

- Guide to understand impacts of signs
- Use to make informed judgments on signs
- Few common signs rigorously studied
- Other reasons to install signs
- Judgement to install signs and judgement to remove them

Project Recommendations

- Research needed for specific signs' effectiveness
- Explore agency experiences with retroreflectivity methods
- Update *Iowa Traffic Control Devices Manual* to reflect MUTCD changes/revisions
- Update "Traffic and Safety Informational Series" FAQ sheets

Questions?

Keith Knapp
kknapp@iastate.edu
515-294-8817

David Veneziano
dvenez@iastate.edu
515-294-5480

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