

International Road Sign Comprehension Evaluation Project

Research results for
UNECE Expert Group
on Road Signs and Signals
by T. Ben-Bassat and M. Pronin
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PROJECT TEAM

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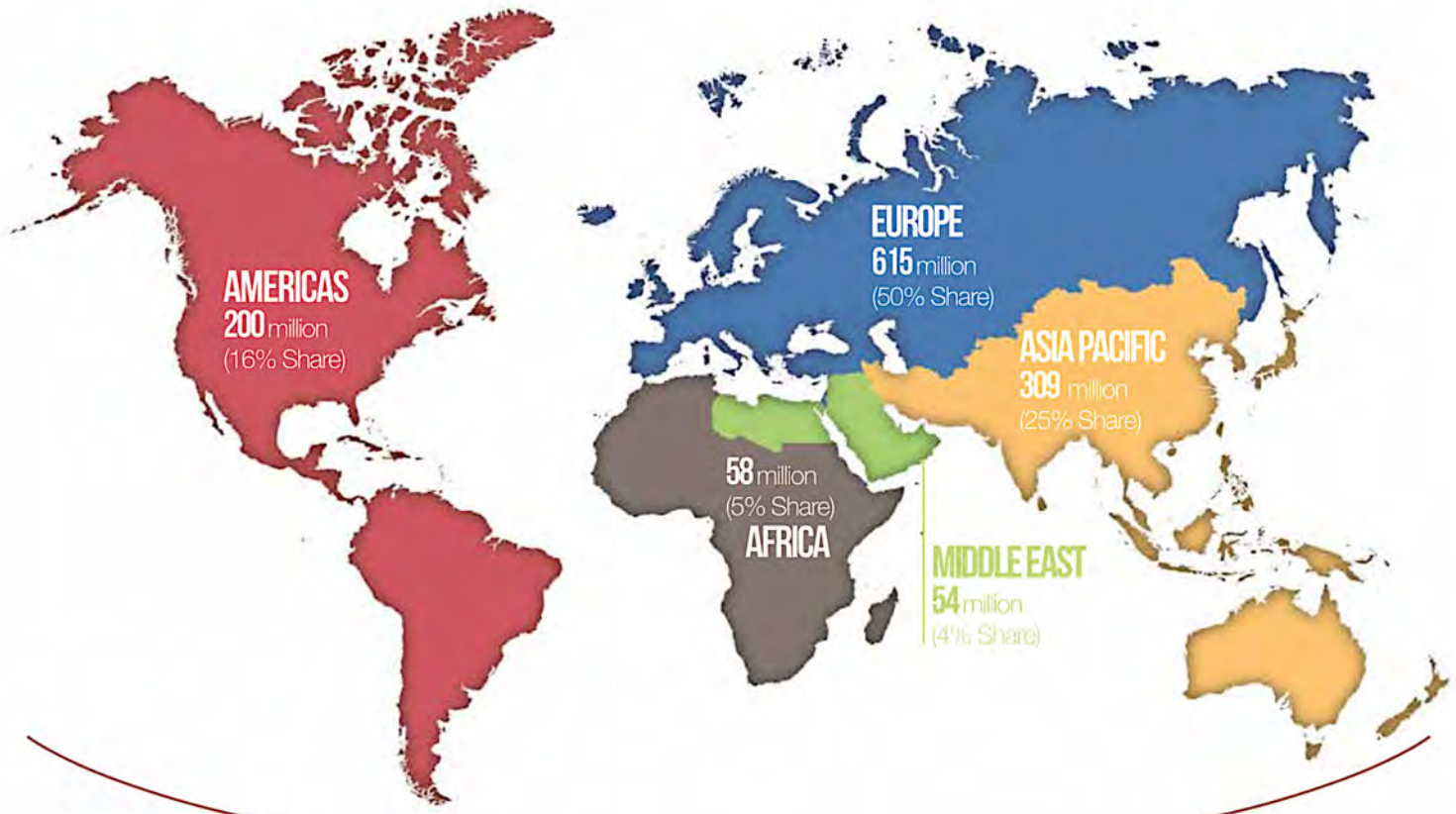
Justification for the Study

✧ Cross-border hazards

- ✧ The issue of comprehension level of road signs used in different countries is critical.
- ✧ Drivers licensed in one country may rent a car and drive it in almost any other country, with signs that may be very different from those they are familiar with.
- ✧ The example of New Zealand: This country has a relatively high number of fatal crashes involving foreign drivers. The Transport Agency attributes the cause to unfamiliar road design and layout, unfamiliar road signs, and distraction by scenery. This puts both foreign nationals and the local population at risk.
- ✧ Even when foreign drivers renting cars receive a booklet showing local signs, they may react based on the signs they have been accustomed to following for years when an instant decision is required.

Cross-Border Hazards

INTERNATIONAL TOURIST ARRIVALS 2016



WORLD: 1,235 MILLION

Cross-Border Hazards

WORLD'S TOP TOURIST DESTINATIONS

INTERNATIONAL TOURIST ARRIVALS 2015



- ✧ Not all tourists rent a car or a motorcycle. Some are cyclists and all are pedestrians. Unfamiliar road signs may confuse all road user categories.
- ✧ These numbers do not include commercial and “drive-through” drivers.

History of Cross-Border Road Sign Research

- ✧ Shinar, Dewar, Summala, and Zakowska (2003) compared sign comprehension of drivers in Canada, Finland, Israel, and Poland:
 - ✧ This research, begun in 1996 and lasting 7 years, was the first attempt to research symbolic road signs on a broad international basis.
 - ✧ They found large differences among signs in their comprehension by the drivers tested.
 - ✧ In each country, local road signs were understood by more people than non-local signs were.
 - ✧ Based on the study results, the authors concluded 15 years ago:
“An international committee...should be reestablished to evaluate both current signs in different countries and proposed new signs.”

- ✧ The current study is a continuation and amplification of this earlier research.

What Is an Ergonomically Designed Sign?

- ✧ Ergonomic design is a field dealing with adjusting products to promote safety and efficiency for the benefit of potential users.
- ✧ Ben-Bassat and Shinar (2006):
 - ✧ **Compatibility** – The correspondence between the sign and the message it represents.
 - ✧ **Standardization** – The extent to which the codes used for different traits like color and shape are consistent for all signs.
 - ✧ **Familiarity** – The frequency of the sign on the road.
- ✧ The standardization and compatibility principles are significant issues when addressing the problem of non-local drivers who are unfamiliar with local signs.
- ✧ In a recent study (in press), Dr. Ben-Bassat found that ergonomically designed unfamiliar road signs (high compliance with Compatibility principle) are significantly more understandable and more easily learned than non-ergonomic signs.

Study Goals

Evaluate road sign designs
based on the signs' compliance
with 3 ergonomic guidelines



Conduct international comprehension research



Offer alternative designs for misunderstood road signs

Methodology

✧ 1) Sign selection

- ✧ Experts from 8 countries proposed Conventional signs for testing with suggestions added from the UNECE Expert Group on Road Signs and Signals.
- ✧ Thousands of signs were reviewed to find Alternatives to compare with Conventional signs. When no viable existing signs were found, original signs were designed.

✧ 2) Pilot Study

- ✧ **Goal:** Refine study methodology to ensure participants understand the instructions and to ensure good operation of computer test system. (Minor adjustments were made.)

✧ 3) Experts Evaluation Study

- ✧ **Goal:** Find Alternative designs that ergonomically rate significantly better than Conventional signs.
- ✧ **99** signs rated by **27** human factors and ergonomics from **10** countries: Australia, Austria, Brazil, Canada, Finland, Israel, Poland, Spain, South Africa, and the USA.
- ✧ The **99** signs consist of **31** Conventional signs, each with **1-3** Alternatives.
- ✧ **Methodology:** Rate signs for compliance with each of the 3 ergonomic principles.
- ✧ **Statistical analysis:** Results tested using an analysis of variance across Alternatives, based on the GEE modeling technique, which considers Alternative designs as repeated measures within respondents.
- ✧ **Results:** For **19** out of **31** signs, an Alternative design was rated as significantly better than the Conventional sign with the same meaning.

Methodology

✧ 4) Main Study – Driver Comprehension and Reaction Time

- ✧ **7** senior researchers from **5** countries took part in the Main Study.
- ✧ **56** signs were tested – **24** Conventional signs and **32** Alternatives.
- ✧ Participants were divided into **3** groups:
 - Novice drivers: Up to 1 year of driving experience.
 - Experienced drivers: >5 years of driving experience and up to 55 years old.
 - Older drivers: 65+ years old.
- ✧ Data collection lasted more than **18** months.
- ✧ Table of sample frequencies:

	Country	Group 1	Group 1	Group 3	Total
Non-CP	Canada	8	81	16	105
	Israel	54	72	48	174
	S Africa	48	50	41	139
CP	Finland	50	50	50	150
	Poland	101	107	92	300
	Total	261	360	247	868

Number of responses:
450 from CP countries and **418** from non-CP countries

Methodology

✧ 4) Main Study – Driver Comprehension and Reaction Time

- ✧ **Goal:** Determine whether drivers better understand a Conventional sign or one of its Alternatives.
- ✧ An internet-based questionnaire created by a professional survey company based on a questionnaire designed by the team.
- ✧ Equipment to be used standardized among all researchers.
- ✧ Demographic questions and open-ended responses comprehension questionnaire, i.e., no multiple choice.
- ✧ Instructions and questions back-translated from English into local languages.
- ✧ Division of the 56 signs to be tested into 2 equal sets with the Conventional sign in one set and at least one Alternative sign in the other set so each participant tested 28 signs (Conventional or Alternative sign from each meaning) randomly presented, i.e., each participant saw the signs in a different order.
- ✧ Experiment in person as a one-on-one survey with no prompting from experimenters.
- ✧ Experiment began with 2 easy practice signs not to be counted in the results.
- ✧ Signs presented on a white background without driving context.
- ✧ Participants' oral responses typed by experimenters during the experiment.
- ✧ Both comprehension level and comprehension response time (in seconds) tested.

Analysis

✧ 4) Main Study – Driver Comprehension and Reaction Time

✧ Data coding:

✧ Oral responses coded into 1 of 4 categories of accuracy:

- ✧ Correct and complete response (coded as +2)
- ✧ Partially correct response (coded as +1)
- ✧ Incorrect response (coded as 0)
- ✧ Opposite of the true sign meaning (coded as -2)

✧ Index of possible responses created to ensure coder consistency.

✧ Oral responses blind-coded by several coders in one or more local languages and translated into English for additional coding and comparison of coding differences.

✧ Extensive discussions held to determine how to code unusual responses.

✧ Response Time (RT):

✧ Measured from the time a sign appeared on the screen until participant indicated comprehension by hitting the computer spacebar key.

✧ **Note:** This study and previous studies proved that reaction time for *opposite* wrong answers is lower than for ordinary wrong answers. This indicates more confidence in the opposite answers and therefore more probability to act quickly in a hazardous way.

Analysis

✧ 4) Main Study – Driver Comprehension and Reaction Time

✧ Statistical analysis:

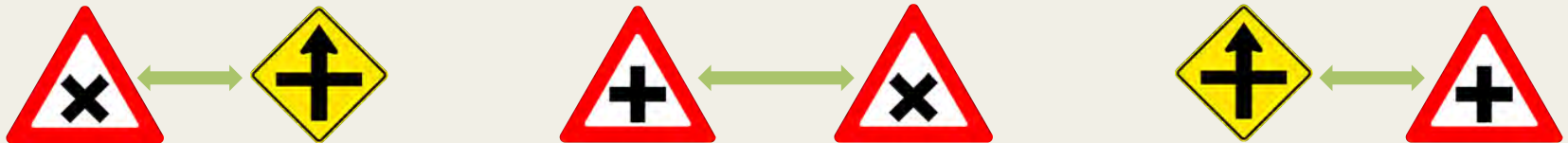
✧ Comprehension accuracy probability analyzed using 2 models:

- ✧ A binary logistic model, which combined categories indicating wrong answers (-2,0 → 0) and categories indicating correct answers (1,2 → 1); and
- ✧ An ordinal logistic model, which included the full scale of coding categories and estimates of the probability to appear in one category vs. the other.

✧ RT tested using GEE model.

When a Conventional sign had more than one Alternative, mean coding grades were compared for each pair of signs.

For example:



Ratings of Signs

Level of Comprehension	Interpretation
80-100%	Excellent
60-79%	Good
40-59%	Fair
0-39%	Very low



Reaction Time (in seconds)	Interpretation
0.0-3.9	Excellent
4.0-5.5	Good
5.6-7.0	Fair
>7.0	Very long





Rating categories are arbitrary.

On the road 3.9 seconds is not excellent, but it may be in a lab test when participants take their time to consider their answers.

Unless stated otherwise, comprehension will be full + partial.

End of Divided Two-way Road (No Lane Loss)


SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Good
	CP	Very low	Very low
 2	Non-CP	Very low	Very low
	CP	Very low	Very low


FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
	Not in code		Not in code	Not in code
				
			Defined differently: end of obstruction, such as traffic island or road work barrier	

COMMENTS

- ✧ **Comprehension & RT Comparison:** Sign 1 better than Sign 2.
- ✧ **Main Wrong Responses:** *Sign 1:* Merging lanes. *Both signs:* Road divides (symbol interpreted from top down).
- ✧ Symbols of Australia (Sign 1) and Canada are used in many countries, both CP and non-CP.
- ✧ The Australian and Canadian symbols have no worldwide harmonized definition. They may or may not indicate reduction in number of lanes (merge required or no merge). The Australian symbol is used in other countries on one-way roads and/or on two-way roads.
- ✧ Most countries use specific warning signs for End of Divided Road. Almost as many use warning signs for Start of Divided Road.
- ✧ **Recommendations:** Convention should address how to indicate End of Divided Road. A sign from section G may provide the most information in one sign without compromising legibility. G, 11c suggests the Convention intends G signs to be used for this purpose. However, the right way to find the best possible sign is to test more signs for comprehension, RT, and legibility.

Example of Comparison by Length of Driver Experience and Age

COMPREHENSION			REACTION TIME
Non-CP	CP	GROUP	Total for All Countries
Good	Fair	Up to 1 year of experience	Good
Fair	Fair	5 years + of experience	Good
Fair	Very low	Over age 65	Very long









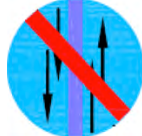
COMPREHENSION			REACTION TIME
Non-CP	CP	GROUP	Total for All Countries
Fair	Very low	Up to 1 year of experience	Very long
Very Low	Very low	5 years + of experience	Fair
Very Low	Very low	Over age 65	Very long

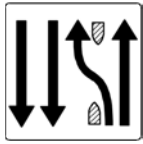
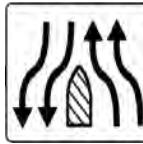
COMMENTS




- ✧ In general, older drivers have lower comprehension probability and significantly higher reaction times than young and middle-aged drivers. This is consistent with previous studies and its implication for road safety is disturbing.
- ✧ As the color coding of the table cells illustrates, each sign must be examined individually to determine which group of drivers in which country has the best and worst comprehension and RT.
- ✧ This extra analysis is provided for these 2 signs only.

Other Considerations

End of Divided Two-way Road (Lane Loss *and* No Lane Loss)



Non-CP		CPs					
							
S Africa	UAE	Pakistan	India	Philippines	Iran / Kuwait	Vietnam	
Definition: End of traffic obstruction	Definition: End of median (divided road)	Many non-CPs use the symbols of Pakistan, India, or Iran on warning signs, with differing definitions					
Example of Different Meanings							




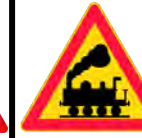

Convention	
	
G, 11c	Intention?
Indication of how this concept may be designed	

Example of Different Meanings		
		
UK	Ireland	Australia
Always merge	Sometimes merge	Never merge

The 3 signs above illustrate the need to examine sign definitions. Harmonized symbols do not guarantee the same definition. Different definitions may endanger foreign road users and, by extension, the local population too.


Level Crossing Without Barrier


SIGN		COMPREHENSION	RT
 1	Non-CP	Excellent	Good
	CP	Excellent	Excellent
 2	Non-CP	Excellent	Good
	CP	Excellent	Excellent

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
				







COMMENTS

- ✧ **Comprehension & RT Comparison:** Signs 1 and 2 are essentially the same.
- ✧ **Main Wrong Responses:** None significant.
- ✧ The EG's preliminary decision was to retain Sign 1 until data from this study (the IRSCEP) became available.
- ✧ The IRSCEP did not initially intend to test Sign1 because it is a good sign. Testing was conducted at the EG's request.
- ✧ The IRSCEP did not test Germany's modern train symbol because it may be mistaken for a tram.
- ✧ **Recommendations:** Sign 1 meets the criteria for retention. However, if the EG prefers to change the symbol, a better choice would be, pending comprehension and legibility testing, a side view of a modern train.

Pro 	<ul style="list-style-type: none"> ✧ As one of the world's best understood signs, change is not justified. ✧ Side view reflects perspective seen by safe drivers. ✧ If Mr. Egger's symbol is chosen to replace A, 25, retaining this sign is essential.
Con	<ul style="list-style-type: none"> ✧ UK researchers suggested some drivers may assume train is slow.

Pro 	<ul style="list-style-type: none"> ✧ Would be consistent with EG's goal to modernize most sign symbols. ✧ 8 CPs have adopted a modern train symbol. ✧ Choosing this particular symbol would acknowledge Africa's contribution to signage.
Con	<ul style="list-style-type: none"> ✧ View of train seen by irresponsible drivers. ✧ Sign 1 may be more legible, but should be tested.



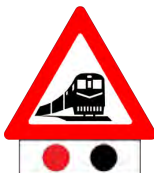
Does Sign A, 26a Suggest a Slow Train?

						
	Slow	Cargo	Steam Engine	Slow	Cargo	Steam Engine
Canada	0	0	0	0	0	0
Israel	0	0	0	0	10	1
S Africa	0	0	0	0	0	6
Finland	0	0	0	0	0	0
Poland	0	0	0	0	0	0
All	>98% did not use words that maybe suggest A, 25a stands for a “slow” train					

COMMENTS

- ✧ No participants said the current sign stood for slow train.
- ✧ A few participants from non-CP countries said “cargo” or “steam engine.” Some cargo trains and steam trains are very fast, but electric trains on average are faster. The study did not use prompting, so we would need to guess if “cargo” and “steam engine” relate to speed in their minds and guessing is unscientific.
- ✧ The percentage of participants who said “cargo” or “steam engine” does not appear large enough to be significant.

Level Crossing with Lights




SIGN		COMPREHENSION	RT
 1	Non-CP	Good	Very long
	CP	Good	Fair
 2	Non-CP	Excellent	Fair
	CP	Excellent	Good
 3	Non-CP	Excellent	Good
	CP	Excellent	Good






FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
Not in code	Not in code	Not in code	Not in code	Not in code

COMMENTS

- ✧ **Comprehension & RT Comparison:** Signs 2 and 3 are essentially the same.
- ✧ **Main Wrong Responses:** None significant.
- ✧ Australia submitted Sign 1 for testing. Lights symbol not used in test countries.
- ✧ Additional panel 2 is similar to symbol style used in the UK.
- ✧ Additional panel 3 is used in Romania and Switzerland.
- ✧ Spain uses sign A, 17a to warn of light signals at level crossings. This is not the Convention's intended use for A, 17a.
- ✧ The UK view is that warning of light signals is more important than warning of automatic barriers.
- ✧ **Recommendations:** Although additional panels 2 and 3 are highly comprehensible, warning drivers of the presence of light signals at level crossings is unnecessary.

Level Crossing with Barrier

SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Fair
	CP	Good	Good
 2	Non-CP	Excellent	Fair
	CP	Excellent	Good
 3	Non-CP	Excellent	Fair
	CP	Excellent	Good

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
				

COMMENTS

- ✧ **Comprehension & RT Comparison:** Signs 2 and 3 are essentially the same overall, with CP comprehension somewhat higher for Sign 3.
- ✧ **Main Wrong Responses:** *Sign 1:* Fence. *Sign 3:* No trains (Canada, a few).
- ✧ Sign 2 is from Chile with the tracks modified for improved legibility.
- ✧ Sign 3 was submitted too late for testing in Israel.
- ✧ Low comprehension for Sign 1 is consistent with results from other studies.
- ✧ **Recommendations:** Sign 1 should be deleted and not replaced or replaced using the symbol in Sign 2 or Sign 3. Germany and all other CPs should have a common definition for A, 26a (see Slide 23).

Signs A, 25 and A, 26a: Choices for the EG

- ✧ **No change**
- ✧ **One sign** (train symbol) for both guarded and unguarded level crossings
 - ✧ Germany and many non-CPs use one sign for both
- ✧ **Two train symbols** for slow cargo train and fast passenger trains
 - ✧ Two non-CPs have 2 warning signs with different train symbols – Not recommended
- ✧ **Revised steam engine symbol** for improved legibility
- ✧ **Modern train symbol** for A, 26a; if yes, which one?
 - ✧ Symbol with front or side view of train
 - ✧ Mr. Egger, the EG's legibility expert, has stated that 8 is the best side view of the train that he has encountered
 - ✧ Symbol with or without a pantograph (Does pantograph suggest a tram?)
 - ✧ In Germany, 10 would possibly not be confused with a tram warning because a section A sign is not used for trams; instead, A, 32 is paired with an additional panel
- ✧ **New guarded symbol** for A, 25; if yes, which one?
 - ✧ If 3, 4, or 5 chosen as the guarded symbol, then 7 should become the unguarded symbol.

Sign images are on next slide

Signs A, 25 and A, 26a: Choices for the EG



Convention
1



Chile's symbol, modified
2



Egger
3



Egger
4



Egger
5



Convention
6



Egger
7

Tested signs or symbols were
1, 2, 3, 6, and 12.



Norway & Ukraine,
informative sign modified
8



Switzerland, proposed
9



Bosnia & Herzegovina, Croatia, Germany,
Luxembourg, Macedonia, Serbia
10





Iran
11





Southern Africa & Nigeria
12

Example of 2 of the Types of Disharmonization




Different symbol for same meaning






Example		
	All Trains	All Trains

Same symbol and different meaning

	Germany	Bosnia & Herzegovina, Croatia, (Iran), Luxembourg, Macedonia, Serbia
Example		
	Guarded & Unguarded Level Crossing	Unguarded Level Crossing

Road Closed in Both Directions

SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Very low
	CP	Good	Good
 2	Non-CP	Fair	Fair
	CP	Very low	Fair
 3	Non-CP	Very low	Fair
	CP	Very low	Good

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
				

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* CP understanding was barely good; combined non-CP / CP responses equals very low comprehension. Poland's understanding was good and RT excellent, while Finland's understanding was fair and RT very long. Israel's understanding was better than Finland's, but Israel's RT was much longer than Finland's. Difference in sign color and border width may explain the results from Finland.
- ✧ **Main Wrong Responses:** *Sign 1:* Do not know. *Sign 2:* Barrier ahead; roadblock; construction. *Sign 3:* No two-way traffic or "end of" two-way traffic; one-way street.
- ✧ Sign 2 is original. Sign 3 is used in India and other Asian countries.
- ✧ Low comprehension for Sign 1 is consistent with results from many other studies.
- ✧ Countries apply Sign 1 to the entire road and, on overhead gantries (permanent) or on the roadbed (temporary), to one side of the road, to one lane, or to the road's shoulder. The Convention permits these applications.
- ✧ Many African countries use the same sign (Convention sign C, 1a) for No Entry and for Road Closed in Both Directions.

South Africa's Signage for Road Closed in Both Directions





Courtesy of © Western Cape Government, South Africa, 2017. Photo cropped.






Courtesy of © Durban University of Technology, South Africa, 2014. Photo cropped.

COMMENTS

- ✧ **Recommendations:** In view of the sign's poor understanding, the EG should decide whether all current applications are suitable for Sign 1. When Sign 1 applies to the entire road or is placed on the roadbed, it should be mounted on a barrier. The IRSCEP used a strict definition for Sign 2. Its comprehension for all study countries combined was significantly higher than comprehension for Sign 1. Therefore, Sign 2 may deserve further study. The EG should also question whether one sign is possible for both No Entry and Road Closed in Both Directions.

No Entry for Pedestrians

SIGN		COMPREHENSION	RT
 1	Non-CP	Good	Excellent
	CP	Excellent	Excellent
 2	Non-CP	Fair	Good
	CP	Excellent	Excellent



FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
				






COMMENTS

- ❖ **Comprehension & RT Comparison:** *Sign 1:* Finland's comprehension was significantly higher than Poland's.
- ❖ **Main Wrong Responses:** *Sign 1:* No crossing (Poland and Canada). *Signs 1 & 2:* End of no pedestrians (Poland). *Sign 2:* No children permitted.
- ❖ The reason for Poland's wrong response is clear, but not for Canada's.
- ❖ IRSCEP's previous study (1996-2003) recorded 93% comprehension for Sign 1.
- ❖ **Recommendations:** Though Poland's sign is more "logical" and more like many No Trespassing signs at railways, Sign 1 should be retained. It is generally understood and in widespread use. A significant number of Polish participants assumed the bar meant "end of," this concern is to be considered if a bar is added to prohibition signs. Sign 2's wrong response is also disturbing and may have implications for Convention sign D, 5, whose comprehension should be tested. D, 5's symbol is used increasingly on warning signs to mean pedestrians walking along the road, though the symbol's use on warning signs is less problematic in terms of comprehension. Nevertheless, the need for 2 pedestrian symbols is questionable.



No Motorcycles

SIGN		COMPREHENSION	RT
 1	Non-CP	Excellent	Excellent
	CP	Excellent	Excellent
 2	Non-CP	Very low	Good
	CP	Good	Excellent

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
				

COMMENTS

- ✧ **Comprehension & RT Comparison:** Finland's and Poland's comprehension were very high and about the same for Sign 1. Poland's comprehension was nearly as high for Sign 2, but Finland's comprehension was much lower and in the fair category. Although Sign 2 is Israel's sign, Israeli comprehension of Sign 1 was excellent while comprehension of Sign 2 was fair. Despite the absence of bars on prohibition signs in their countries, Poland and Israel had shorter RTs for Sign 1 than for Sign 2.
- ✧ **Main Wrong Responses:** *Sign 2:* Motorcycle lane; motorcycles permitted; warning of motorcycles on road. *Sign 2:* End of no motorcycles (Poland, a few).
- ✧ IRSCEP's previous study (1996-2003) recorded 64% comprehension for Sign 2.
- ✧ **Recommendations:** The assumption by a portion of Polish participants, for all prohibition signs with bars tested (4 signs with single bars and 1 sign with double bars), that the bar means "end of prohibition" leads to the dangerous interpretation of signs as having their opposite meaning. This reveals the hazard of allowing 2 separate systems (bar and no bar) to deliver the same message. A bar should nevertheless be used on prohibition signs because it considerably enhances comprehension and significantly reduces RT. However, because a bar reduces a sign's legibility, the issue of comprehension vs. legibility must be considered before making a decision. The best solution is a compromise that the Convention currently allows: placing the bar behind the symbol. The Convention also allows placement in front of the symbol. These 2 options should be retained, with the preferred option being the bar behind the symbol.

Comprehension Vs. Legibility

✧ In 1988 Dr. Dewar published a survey of 153 road sign experts and practicing traffic engineers from Australia, New Zealand, Canada, and the USA on the importance of 6 criteria in evaluating design symbols. Comprehension was rated the highest, above legibility and other criteria for, on average, all types of signs: warning, regulatory, and informative.

✧ For all prohibition signs with bars in the study, the presence of a bar, whether behind or in front of the symbol, was understood with extremely high comprehension as a prohibition. That is, the concept of prohibition was understood whether or not the symbol was identified correctly.











✧ According to Dr. Shinar, the human mind can complete the bar more easily than completing the more complex symbol: “My conclusion rests on the well-known findings of Gestalt Psychology concerning some very robust rules of visual perception. Among these rules is one called 'good continuity,' which states that the human mind fills in the blanks for missing (visual) data by assuming that there is 'continuity' between the segments. For instance, a circle made up of dots is perceived as a circle and not as individual dots. The mind assumes that a straight line (e.g., a fence) that is obscured on some segments is still there behind the occluding objects (e.g., people leaning on the fence). In contrast, the individual markings of a symbol do not provide the good continuity of a straight line; therefore, reconstructing it from the partial image is more difficult for the mind.”






✧ In 2002 Dr. Wogalter published research on 4 types of prohibition bars. Different results were obtained with different symbols, but, on average, comprehension was 88% for bars in front and 100% for bars behind the symbol.

✧ There are 2 types of incomprehension of a symbol: 1) not understanding its meaning and 2) not understanding it because it is obscured. Placing the bar behind the symbol minimizes or eliminates the second type of incomprehension: obscuration.

Cycle Lane or Track Only

SIGN		COMPREHENSION	RT
 1	Non-CP	Fair	Excellent
	CP	Very low	Excellent
 2	Non-CP	Excellent	Excellent
	CP	Excellent	Excellent
 3	Non-CP	Excellent	Excellent
	CP	Excellent	Excellent

FAMILIARITY - Mandatory				
Canada	Israel	S Africa	Finland	Poland
				

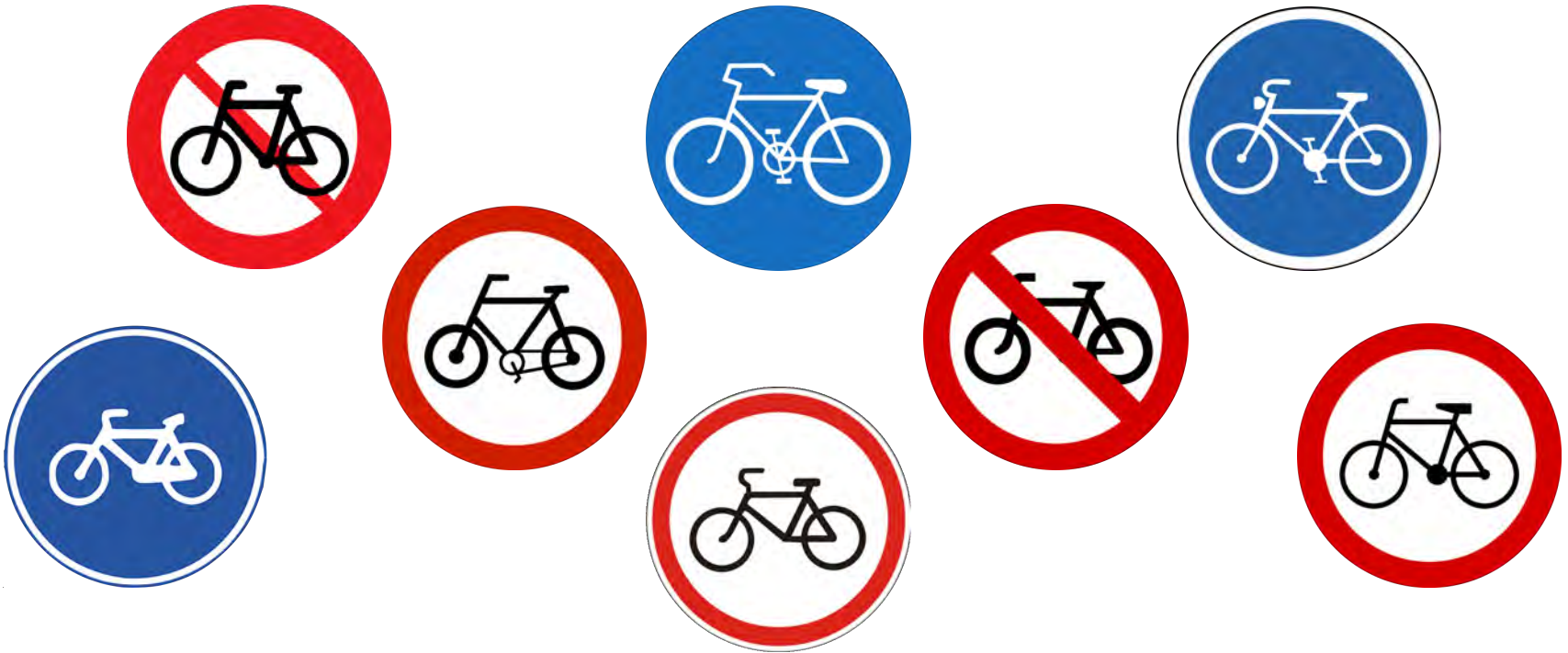
FAMILIARITY - Prohibitory				
Canada	Israel	S Africa	Finland	Poland
				

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* Comprehension was extremely low in Poland and Israel; good comprehension in Canada led to average non-CP rating of fair. Finland's comprehension was much better than Poland's and was essentially the same as South Africa's. *Sign 3:* The best comprehended sign, with almost perfect understanding.
- ✧ **Main Wrong Responses:** *Sign 1:* Cycles prohibited. *Signs 2 & 3:* None significant.
- ✧ The 3 countries with the better understanding of Sign 1 all have prohibition signs with bars.
- ✧ Sign 1 is Brazil's mandatory sign. The same sign model is used throughout Latin America for mandatory signage.
- ✧ IRSCEP's previous study (1996-2003) recorded 89% comprehension for Sign 2. Results from the current study are similar.
- ✧ **Recommendations:** The Convention distinction between prohibitory signs (red border) that may not have bars and the second mandatory model (red rim) is too subtle. In practice, the signs of every country using the second mandatory model have the wide border instead of the narrow rim, which makes these signs indistinguishable from prohibition signs without bars. To create the greatest distinction between prohibitory and mandatory signage, the Convention should sanction only one mandatory model: blue roundel with white symbol.




Cycle Lane or Track Only





A reminder: Excellent RT means short RT. When combined with opposite answers, it indicates driver confidence in the opposite meaning of the sign. This occurred with most participants for Sign 1 and it represents a major hazard.



This slide has 4 prohibitory signs and 4 mandatory signs.
Can drivers and cyclists correctly identify them?

Give Way Ahead

SIGN		COMPREHENSION	RT
 1	Non-CP	Fair	Very long
	CP	Fair	Fair
 2	Non-CP	Good	Fair
	CP	Excellent	Excellent
 3	Non-CP	Fair	Very long
	CP	Fair	Very long

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
	Not in code			











Other sign type used in Western Hemisphere

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* Comp
- ✧ **Main Wrong Responses:** *Signs 1 & 3:* Some type of warning; do not know. *Sign 2:* None significant.
- ✧ Canada's sign is used widely in the Western Hemisphere. Its shape and color provide more visual prominence for a give way symbol with a white ground than a triangle with a white ground does. This prominence may raise comprehension. Some countries replace the arrow with the distance.
- ✧ **Recommendations:** Sign 1 should be deleted from the Convention. The EG should consider whether Sign 3's symbol is acceptable as an alternative for warning model Ab. This would represent permitting regulatory sign symbols on warning signs, which the Convention already does with 3 signs, A, 20 and A, 21a/b.

Stop Sign Ahead

SIGN		COMPREHENSION	RT
 1	Non-CP	Fair	Very long
	CP	Very low	Fair
 2	Non-CP	Excellent	Good
	CP	Good	Excellent
 3	Non-CP	Excellent	Excellent
	CP	Excellent	Excellent
 4	Non-CP	Excellent	Excellent
	CP	Excellent	Excellent




FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
				Not in code







COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* Least comprehensible. *Sign 2:* Poland's comprehension was not good; the rating was raised by Finland's higher comprehension. *Sign 4:* Best in comprehension and RT despite not used in the countries tested.
- ✧ **Main Wrong Responses:** *Sign 1:* Do not know; tunnel. *Sign 2:* Give way (many participants). *Signs 3 & 4:* None significant.
- ✧ Canada's sign is used widely in the Western Hemisphere. Some countries inscribe the sign in the local language and/or replace the arrow with the distance. Ireland uses Sign 4 without the inscription. Cyprus uses a symbol on the additional panel; with modification, it may be worth testing.
- ✧ **Recommendations:** Sign 1 should be deleted from the Convention. The EG should consider replacing Sign 2 with Sign 3 or Sign 4. One EG member stated that Sign 4 would be hazardous if the additional fell off the sign post.

Priority for Left Turn

SIGN		COMPREHENSION	RT
  1	Non-CP	Very low	Very long
	CP	Good	Very long
 2	Non-CP	Very low	Fair
	CP	Very low	Good

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
Not in code	Not in code	Not in code	 	 



Example of one of Sweden's signs

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* The very long time required to interpret the sign is an indication of unacceptability.
- ✧ **Main Wrong Responses:** *Signs 1 & 2:* Confusion about which roads have priority.
- ✧ The Convention permits sign assemblies, such as the combination tested in Sign 1. A relatively simple combination was chosen for testing. Many sign assemblies seen on the road have more complicated symbols with greater potential to confuse drivers. It may be contradictory that the Convention permits indication of priority at bends and intersections by attaching H, 8 additional panels to warning signs and also permits new A, 19 signs to be created based on road layout. Initially, Sweden was the only CP to create a large number of A, 19 signs (21). Today, Estonia, Hungary, and Vietnam have more A, 19 signs than are displayed in the Convention.
- ✧ Sign 2 is an original design based on the Convention's H, 8 symbol.
- ✧ **Recommendations:** Additional panels should amplify a sign's message, not contradict it. Sign assemblies, such as Sign 1, should be replaced by specific A, 19 signs. Comprehension of Sign 2 is too low for consideration. The symbol design used in Sweden is also used by the other 3 CPs and this favors its adoption. Also to be weighed is depiction of minor roads or driveways on A, 19 signs rather than on additional panels because the sign assemblies lead to the same contradictions that occur with A, 19 sign. New trends in signage favor consolidation of symbols into one panel.

Priority for Left Turn











Courtesy of © Morgan, Belgium, 2014.





Sweden's probable sign for this intersection



Crossroad

SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Fair
	CP	Good	Excellent
 2	Non-CP	Good	Good
	CP	Good	Good
 3	Non-CP	Fair	Very long
	CP	Fair	Fair



FAMILIARITY NATIONAL PRIORITY RULE				
Canada	Israel	S Africa	Finland	Poland
				






FAMILIARITY PRIORITY STRAIGHT AHEAD				
Canada	Israel	S Africa	Finland	Poland
	Not in code			

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* The best CP comprehension. *Sign 2:* The best comprehension overall.
- ✧ **Main Wrong Responses:** *Sign 1:* Level crossing. *Sign 2:* Hospital. *Sign 3:* Must drive straight ahead.
- ✧ Two different concepts were combined for this sign test.
- ✧ Sign 1 resembles Canada's level crossing sign (see Slide 17). It explains why many Canadian participants assumed the sign stood for level crossing, but it does not explain why some participants from the other countries also answered "level crossing."
- ✧ **Recommendations:** A symbol reflecting the road layout is theoretically to be preferred. However, the high percentage of participants who interpreted Sign 2 as relating to a hospital (or ambulance) precludes its recommendation.

End of Priority Road

SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Very long
	CP	Good	Good
 2	Non-CP	Good	Very long
	CP	Good	Good

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
Not in code				 



COMMENTS






- ✧ **Comprehension & RT Comparison:** *Sign 1:* Poland's comprehension and RT are outstanding. Finland's comprehension barely made the good category and Finland's RT was 2.5 times longer than Poland's RT. *Sign 2:* Better comprehension overall than Sign 1 resulting from much better comprehension for non-CPs, but much lower comprehension for Finland (somewhat) and Poland (very significant).
- ✧ **Main Wrong Responses:** *Sign 1:* Do not know. *Sign 2:* End of the road; end of public road.
- ✧ Dr. Summala has studied hazards at intersections in Finland and observed drivers in many European countries. He considers non-comprehension of Convention sign B, 4 to be one of the greatest hazards to drivers.
- ✧ IRSCEP's previous study (1996-2003) recorded ~47% comprehension for Sign 1. This is consistent with results from other studies.
- ✧ Poland's high level of comprehension may be due to its unusual sign assembly on the road. Participants correctly identified Sign 1 even though the test did not couple Sign 1 with the give way sign. (During testing, Poland's participants saw only Sign 1 and not the sign assembly.)
- ✧ The inscription in a foreign language did not assist Finland or Poland in reaching or surpassing their comprehension of Sign 1. (See also Slide 43.)
- ✧ Israel's low comprehension was possibly due to an inscription not in the alphabet of the national language.
- ✧ **Recommendations:** Though symbolic signs are preferable to inscribed signs, the symbols must be comprehensible. Among non-CPs countries Sign 1 was extremely less comprehensible than Sign 2. Sign 1 is problematic though so ubiquitous in Europe that resistance is to be expected to its replacement. Dr. Lehtonen states that it is justified to replace an old sign with a new design that has been evaluated to be better. Another approach may be to require an additional panel to accompany all Sign 1 installations. Testing is required to determine what type of signage would be most comprehensible.

Poland's Solution to Raise Comprehension of Sign B, 4



Priority for Oncoming Traffic

SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Very long
	CP	Good	Good
 2	Non-CP	Very low	Very long
	CP	Good	Fair

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
				





Quebec






New Zealand's
sign assembly

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* Comprehension in all 5 countries was lower than comprehension for Sign 2. The difference ranged from slight to major (insignificant to significant).
- ✧ **Main Wrong Responses:** *Sign 1:* Wider lane on the left; two-way street; no overtaking. *Sign 2:* Give way ahead.
- ✧ Sign 2 is original.
- ✧ Quebec has no sign for Your Priority.
- ✧ IRSCEP's previous study (1996-2003) recorded ~57% comprehension for Sign 1. This is consistent with results from other studies.
- ✧ **Recommendations:** Sign 2 should be considered as a replacement for Sign 1. More testing may also be done with Quebec's sign and New Zealand's sign assembly.

Roundabout



SIGN		COMPREHENSION	RT
 1	Non-CP	Excellent	Excellent
	CP	Excellent	Excellent
 2	Non-CP	Excellent	Excellent
	CP	Excellent	Excellent




FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
				
Right	Right	Left	Right	Right

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Signs 1 & 2:* Almost equal excellent comprehension across all countries.
- ✧ **Main Wrong Responses:** None significant.
- ✧ As study controls, 2 signs, one with expected very high and one with expected very low level of comprehension, were chosen. This was the sign expected to be easy to understand.
- ✧ Of particular interest was the comprehensibility in a country where driving was on the other side of the road from the side depicted on the sign. Arrow direction did not confuse participants. South Africa performed as well as the other countries.
- ✧ High level of comprehension for both signs is consistent with results from other studies.
- ✧ **Recommendations:** These signs require no alteration.

Start of Built-up Area



SIGN		COMPREHENSION	RT
 1	Non-CP	Excellent	Fair
	CP	Excellent	Excellent
 2	Non-CP	Excellent	Good
	CP	Excellent	Excellent






FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
Not in code		Not in code		

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* Almost no one mentioned lower speed limit. *Sign 2:* The vast majority mentioned lower speed limit.
- ✧ **Main Wrong Responses:** None significant.
- ✧ Signs 1 and 2 are understood well even in countries that do not have the sign.
- ✧ **Recommendations:** Sign 1 requires no alteration, but communities must ensure awareness of the reduced speed limit(s) in built-up areas.

End of Maximum Speed Limit

SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Fair
	CP	Excellent	Excellent
 2	Non-CP	Good	Fair
	CP	Excellent	Good

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
				
New speed limit posted		New speed limit posted		



COMMENTS





- ✧ **Comprehension & RT Comparison:** *Sign 1:* Huge number of opposite answers (Canada and South Africa).
- ✧ **Main Wrong Responses:** *Sign 1:* Maximum speed limit is 40; minimum speed limit is 40. *Sign 2:* Maximum speed limit is 70 and minimum is 40.
- ✧ **Maximum speed limit:** Is the word “limit” necessary?
- ✧ **Recommendations:** It would be more direct to install signs for the new speed limit, as is done in Canada, South Africa, and most of the rest of the world. Posting Sign 1 without posting the new speed limit places a burden on drivers to recall the previous speed limit. Also, drivers may enter some roads from a direction where the previous speed limit is not obvious. Dr. Lehtonen states that Sign 1 deserves to be deleted completely; he asks what is the point of saying the speed limit ends without saying what is next? Posting Sign 1 with the new speed limit sign nearby is redundant. However, Sign 1 would still need to be retained for End of Zone signs.

End of Maximum Speed Limit – Are 2 Signs Needed?



Minimum Speed

SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Excellent
	CP	Very low	Excellent
 2	Non-CP	Good	Good
	CP	Excellent	Excellent

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
			Not in code	



Finland
advised speed limit






COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* Poland's comprehension, although only fair, was much higher than Finland's. *Sign 2:* Comprehension was excellent in all countries except Israel, where it was rated as good.
- ✧ **Main Wrong Responses:** *Sign 1:* Maximum speed limit; advised speed; order to drive at 50 km/h (many in Poland). *Sign 2:* None significant.
- ✧ Many Finnish participants believed Sign 1 stood for advised speed limit, but only a few believed Sign 2 stood for advised speed limit. Dr. Lehtonen believes Finland's comprehension was low because Finland does not use a minimum speed limit sign and motorway ramps often have advised speed limit signs, which resemble Signs 1 and 2 except for shape. Although Finland's sign is more similar to Sign 2, the "min" inscription led to a high number of correct responses presumably because minimum in Finnish is *minimi*.
- ✧ For Sign 2, comprehension was also high in Poland, where minimum in Polish is *minimum*, and in the mostly English-speaking non-CPs (Canada and South Africa). Comprehension was lowest in Israel, where the alphabet is different and minimum is גְּיִנְיָמוֹם. An inscription not in the alphabet of the national language may be responsible for the comparatively lower comprehension, similar to the result for the inscribed sign on Slide 36 where Israeli comprehension was also the lowest. (Comprehension and inscriptions in a foreign language are discussed on Slides 51 and 52.)
- ✧ A question raised by Finland's many "advised speed limit" responses is whether shape alone is enough to distinguish different sign meanings.
- ✧ Low level of comprehension of Sign 1 is consistent with results from other studies.
- ✧ **Recommendations:** Many years ago, minimum speed limit signs in Europe were inscribed. Removing the inscriptions resulted in a cleaner-looking design, but it may have lowered comprehension. Reintroducing an inscription is worth considering.

Toll Ahead, Stopping Required

SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Very long
	Fair	Very low	Fair
 2	Non-CP	Excellent	Fair
	CP	Excellent	Excellent

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
Not in code			Not in code	



Sweden










France

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* Very low for all countries.
- ✧ **Main Wrong Responses:** *Sign 1:* Do not know; do not enter; border crossing (Poland, a few). *Sign 2:* None significant.
- ✧ Several CPs have created specific informative signs for different types of tolls; e.g., France has 6 signs.
- ✧ Sign 2 is an original design.
- ✧ **Recommendations:** Replace Sign 1. If the EG prefers one general sign for tolls, an informative sign with a symbol of a road and payment options would ensure good comprehension. Sign 2 is based on a recognizable Convention sign. However, Sign E, 5a may be too specific because not all toll roads are motorways and bridges and tunnels may have tolls. Israel and Sweden use a general road symbol. Sweden's symbol does not specify currency, which allows the same symbol to apply to all, but it may not be understandable without the hand. It is likely that all C, 16 signs will have low comprehension outside their immediate region. Replacing these signs with symbolic signs should be considered. Some of C, 16's other uses are for customs, border control, police and military checkpoints, ferry entrance, light signals, and temporary roadway hazards. Several CPs have created an informative sign with a symbol for customs. A few CPs and many non-CPs use a warning sign for ferry entrance.

No Stopping

SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Very long
	CP	Good	Excellent
 2	Non-CP	Very low	Very long
	CP	Very low	Very long

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
				










Symbol with possibly better memorability

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* Finland's comprehension was significantly better than Poland's.
- ✧ **Main Wrong Responses:** *Sign 1:* Do not enter; do not know. *Sign 2:* No parking; do not know.
- ✧ Low level of comprehension of Sign 1 is consistent with results from other studies.
- ✧ Sign 2 is an original design by a European member of the EG (not Mr. Egger).
- ✧ **Recommendations:** Sign 1's design is unfortunate because it may be read as end of no parking. A double parallel bar sloping downward from left to right may have been more "logical": one bar for no parking and 2 bars for the stronger prohibition of no parking and no stopping. Sign 1 is surprisingly not as well understood as expected in CPs countries and hardly understood in non-CP countries, but it is so ubiquitous in Europe that resistance is to be expected to its replacement.

Crosswind



SIGN		COMPREHENSION	RT
 1	Non-CP	Fair	Very long
	CP	Excellent	Excellent
 2	Non-CP	Good	Good
	CP	Good	Excellent









FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
				

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Signs 1 & 2:* Most answers were “wind” rather than “crosswind” or “side wind.”
- ✧ **Main Wrong Responses:** *Sign 1:* Airport nearby. *Sign 2:* Slippery road; water on road.
- ✧ Sign 2 is based on Central America’s crosswind warning sign.
- ✧ Low level of comprehension of Sign 1 in non-CPs is consistent with results from another study in China. High level of comprehension in CPs is consistent with results from another study in Denmark.
- ✧ **Recommendations:** Sign 1, due to familiarity, is expected to be better understood in Europe than outside Europe. Sign 2 was better understood, on average, by more drivers despite not being a familiar sign in any of their countries. Sign 2 is the better sign, but the symbol should be redesigned to erase any suggestion of a wave of water.

End of Paved Road



SIGN		COMPREHENSION	RT
 1	Non-CP	Good	Fair
	CP	Good	Good
 2	Non-CP	Good	Fair
	CP	Good	Good






FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
	Not in code			
	Not in code			

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Signs 1 & 2:* Comprehension was essentially the same regardless of sign model; CP RT was better despite the absence of the signs in the CPs tested.
- ✧ **Main Wrong Responses:** *Signs 1 & 2:* Rocks on road.
- ✧ Some CPs use Convention sign A, 10 (Loose Gravel) for End of Paved Road, but other CPs apply A, 10 only when the road has gravel for a short distance (such as at road works).
- ✧ Quebec and South Africa use A, 10, but only for temporary conditions.
- ✧ **Recommendations:** If the EG prefers to distinguish between end of a paved road leading to a long stretch of unpaved road and a short section of gravel road, then the symbol in Signs 1 and 2 should be added to the Convention.









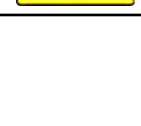
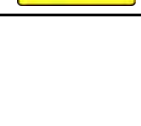

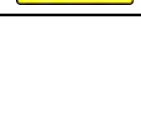
Crash Ahead (temporary) or High Risk Area (permanent)

SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Fair
	CP	Very low	Good
 2	Non-CP	Excellent	Fair
	CP	Good	Good

FAMILIARITY CRASH AHEAD				
Canada	Israel	S Africa	Finland	Poland
Not in code			Not in code	
				

COMMENTS

- ❖ **Comprehension & RT Comparison:** *Signs 1 & 2:* Comprehension of Sign 2 is much better than Sign 1 as a general warning of a high risk area. Even the countries with Sign 1's symbol better understood Sign 2.
- ❖ **Main Wrong Responses:** *Signs 1 & 2:* Signs stand for specific types of crashes. *Sign 1:* Rollover danger.
- ❖ Some CPs (Belarus, Denmark, Hungary, Norway, Poland, and Ukraine) use several additional panels to convey specific types of high risk areas.
- ❖ Germany has specific additional panels too (car striking tree, cycle, and motorcycle, but it is unclear if they are part of national signage).
- ❖ Kuwait has a warning sign specifically for rollover danger.
- ❖ **Recommendations:** Though R.E.2 Sign 1 probably has better legibility, it should be replaced by the more comprehensible Sign 2. The EG should consider whether numerous additional panels for specific types of crashes are warranted.

FAMILIARITY HIGH RISK AREA				
Canada	Poland			
Israel				
S Africa				
Finland				
Not in code				

Specific High Risk Area Signs



Norway



Hungary



Germany



Denmark



Kuwait



Ukraine





Romania, Moldova



Belarus

Reduced Visibility

SIGN		COMPREHENSION	RT
 1	Non-CP	Very low	Very long
	CP	Very low	Very long
 2	Non-CP	Excellent	Fair
	CP	Excellent	Good

FAMILIARITY				
Canada	Israel	S Africa	Finland	Poland
Not in code	Not in code	Not in code	Not in code	Not in code

COMMENTS

- ✧ **Comprehension & RT Comparison:** *Sign 1:* Poland's comprehension was higher than Finland's. *Sign 2:* Finland's comprehension was higher than Poland's.
- ✧ **Main Wrong Responses:** *Sign 1:* Tunnel; crosswalk; do not know. *Sign 2:* None significant.
- ✧ Sign 1 is based on R.E.2's VMS, which is adapted from the Czech Republic's fixed sign for low visibility and is similar to Slovakia's sign.
- ✧ **Recommendations:** Sign 1's symbol should be replaced. Although Sign 2 has excellent levels of comprehension, the symbol's delicate detail render it impractical for fixed signage and VMS. More research is needed to find a symbol with sufficient comprehensibility and legibility.

Inscribed Signs in a Foreign Language

- ✧ Dr. Choocharukul has generously permitted excerpts from his research to be included in this presentation.
- ✧ In 2017 he published the results of a study of tourist comprehension of Thai road signs conducted by him with colleagues.
- ✧ Comprehension of 20 signs by 1091 foreign drivers from 5 continents were surveyed:
 - ✧ Of the 20 signs, 2 (Stop and Give Way) were inscribed in the local language.
 - ✧ Questions were open ended.
- ✧ Previous studies on Stop signs by other researchers revealed:
 - ✧ Inscribed in the local language or in English: 89-100% comprehension.
 - ✧ In Saudi Arabia, inscribed in Arabic 96% comprehension and in English 92%.
- ✧ Previous studies on Give Way signs by other researchers revealed:
 - ✧ Inscribed in the local language: 81-96% comprehension.
- ✧ According to Dr. Choocharukul, results revealed that inscribed signs in a language not understood by drivers lowers comprehension of the signs.

Source: K. Choocharukul and K. Siroongvikrai, "Road Safety Awareness and Comprehension of Road Signs from International Tourist's Perspectives: a Case Study of Thailand," *Transportation Research Procedia*, 2017.

Inscribed Signs in a Foreign Language

Comprehension Results



%	Region
51	Africa
20	Asia
36	Australia
57	Europe
67	North America
47	ALL



%	Region
-	Africa
13	Asia
32	Australia
36	Europe
47	North America
31	ALL

Totals are not simple averages of the continent percentages because number of participants varied by region.

Source: Authors' data; K. Choocharukul and K. Siroongvikrai, "Road Safety Awareness and Comprehension of Road Signs from International Tourist's Perspectives: a Case Study of Thailand," *Transportation Research Procedia*, 2017.

Summary

- ✧ Sign design dramatically affects comprehension.
- ✧ Nearly everyone understands some signs even if they are not used in their country and are unfamiliar to drivers.
- ✧ Conversely, most drivers misunderstand some signs even if the sign has been used in their country for more than a century.
- ✧ For 14 out of 24 signs, an Alternative sign had higher comprehension probability; for 6 signs, the Conventional sign had higher comprehension probability. No significant difference was recorded for 4 signs.
- ✧ Based on the study data's soundness and the research team's expertise, signs with significant comprehension probability may be added, replaced, or deleted.
- ✧ When proposing sign changes, ergonomics is not the only consideration. Practicality (cost and consistency with the signs in other countries) is part of the decision.

Summary

- ✧ On average, older drivers' comprehension probability is lower than that of younger drivers'.
- ✧ On average, older drivers' RT is dramatically higher than that of younger drivers; slow RTs may have critical implications for older drivers.
- ✧ Broadening our the research to include more signs and more countries would provide data for issues that are still outstanding.
- ✧ To complete the sign selection process, legibility testing should be conducted on signs with high comprehension probability.
- ✧ National educational programs to raise sign comprehension would be welcome, but their effectiveness is limited to local populations.
- ✧ Misunderstood signs must be acknowledged as an international problem. If CPs have good sign comprehension and non-CPs do not or vice versa, it matters everywhere due to the amount of international driving.

Thank you



Cargo train traveling in snow drifts at ~100 km/h