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PRIORITY 1.6. Sustainable Development, Global Change and Ecosystem
1.6.2: Sustainable Surface Transport



506716

Title	Results of the Comprehension Test on Animated Pictograms conducted in Austria and the Czech Republic
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Summary	The Comprehension Test on Animated Pictograms was conducted in two European countries. This test was performed as a flash-based animation. 308 participants took part. 21 variants of 13 pictograms were evaluated. Six referents scored higher than the required score of 66.
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List of Abbreviations

CAT	Comprehension Test on Animated Pictograms
2 nd CT	2 nd Comprehension Test
CDV	Centrum dopravného výzkumu
CJT	Comprehensibility Judgement Test
CT	Comprehension Test
DUK	Danube University Krems
IIID	International Institute for Information Design
In-Safety	Infrastructure and Safety
ISO (9186)	ISO Standard 9186: „Test methods for judged comprehensibility and for comprehension”
ITS	Intelligent Transport Systems
VMS	Variable Message Sign(s)

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PARTICIPATING BODIES / CREDITS

This test was carried out under the Sixth Framework Programme of the European Commission, within the Project "IN-SAFETY", Activity A2.2 "Pictograms substituting verbal messages on VMS".

Submitting party, Leader of Work Package 2 and Activity A2.2:

International Institute for Information Design (IIID), Vienna, Austria

Leader of Testing Activities, Testing Partner and Analysis:

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1. INTRODUCTION

The IN-SAFETY Project focuses on the prerequisites for a successful implementation of Intelligent Transport Systems (ITS) in order to enhance the self-explanatory nature of roads.

European drivers have to cope with increasingly complex traffic environments, including vertical and horizontal signing; which is often supported by Telematics. Thus, there is a high need for a self-explanatory road environment at a personalized level which would offer intuitive guidance to the driver and information when this is needed. The information given should be related to the driver's particular needs (route, disabilities, preferences, etc). A self-explanatory road will protect the driver from making errors and will enhance his/her comfort.

Due to the fact that information displayed on Variable Message Signs (VMS) is usually shown in the local language, the complexity of information is confusing and leads to driver mistakes and safety risks. The objective of this activity within work package 2 is to increase the self-explaining road environments by presenting a proposal of homogenized and comprehensive pictograms to substitute verbal messages on VMS.

2. METHOD

2.1. Test procedure

The defined stages for the development and testing procedure of pictograms recommended within the final IN-SAFETY proposal are:

- 1) Collection of the information needed concerning the standardization of graphical symbols and the technical requirements of VMS.
- 2) Collection of a set of existing and proposed variants for each referent/meaning.
- 3) Comprehensibility Judgement Test, according to ISO 9186, to eliminate incomprehensible solutions at an early stage: The Comprehensibility Judgement Test was conducted in April 2006, in four European countries, for 33 referents a total of 243 variants were tested by a total of 825 respondents. 56 variants have been taken into account for further testing, several variants were proposed for redesign.¹
- 4) The Comprehension Test (CT), according to ISO 9186, was conducted in three European countries, and performed as a Paper and Pencil Test. 84 variants of 33 referents had been tested and evaluated by 604 participants. 20 of the referents reached the ISO score of 66 and were recommended for the final proposal.² 11 variants were proposed for redesign and retesting.

¹ See: Brugger Ch. (2006): Comprehensibility Judgement Test; Report In-Safety, 506716. 30/04/2006.

² See: Siebenhandl K., Brugger Ch., Simlinger P., Egger S., Hollo P., Weinberger J., Vasek J. (2007): Results of the Comprehension Tests on pictograms conducted in Austria, the Czech Republic and Hungary; Report In-Safety, 506716. 05/01/2007.

- 5) The outcomes of the 2nd Comprehension Test (2nd CT), concerning the retesting of 16 variants were addressed within an additional paper. The 2nd CT was conducted in two countries, and was performed as a Paper and Pencil Test. 16 variants of 12 referents had been retested after redesign following the recommendations of the 1st CT. This test was answered by 307 participants. Eight referents reached the required ISO score of 66.³
- 6) Checking comprehensibility of variants under conditions of impaired vision.
- 7) The Comprehension of Animated Pictograms is addressed within this paper. The test results will be compared to the results of static pictograms in order to elaborate the influence of animation on comprehension.
- 8) Acceptance as a standard graphical symbol, which has been evaluated the most comprehensible and surpasses the criterion of acceptability.

The evaluation criteria and methods for testing follow the ISO 9186 “Test methods for judged comprehensibility and for comprehension”⁴. Details on applying the CT can be found in this standard.

2.2. Aim of the Comprehension Test on Animated Pictograms

This test was to elaborate the influence of animation on the comprehension of pictograms which were evaluated in previous research.⁵ It was conducted screen based. Participants were seated in a drivers’ seat in front of animations, which were projected on a wall.

Participants were given a short verbal instruction beforehand, telling them to imagine driving along a highway, where they are to encounter graphic symbols. After spotting an (animated) pictogram, they were asked for its meaning and what their reaction in response to this meaning would be.

In detail, three types of animation were employed:

- static pictograms with superimposed danger or prohibition elements, creating a flashing appearance,
- (static) pictograms with a prohibition element

³ See: Siebenhandl K., Brugger Ch., Simlinger P., Egger S., Weinberger J. (2007): Results of the 2nd Comprehension Test on pictograms conducted in Austria and the Czech Republic; Report InSafety, 506716. 24/08/2007.

⁴ ISO, International Standardization Organization (2001): ISO 9186, Graphical symbols – Test methods for judged comprehensibility and for comprehension. Geneva: ISO.

⁵ See: Brugger Ch. (2006): Comprehensibility Judgement Test; Report In-Safety, 506716.

Siebenhandl K., Brugger Ch., Simlinger P., Egger S., Hollo P., Weinberger J., Vasek J. (2007): Results of the Comprehension Tests on pictograms conducted in Austria, Czech Republic and Hungary; Report In-Safety, 506716. 05/01/2007.

- animated pictograms, consisting of picture frames shown in fast succession, to create a film that transports messages which cannot be delivered by a static symbol

Special attention was drawn to the possibility of employing superimposed elements to communicate warnings and prohibitions. Danger warning triangles and prohibition elements were superimposed over a graphical symbol, which normally surround the symbol restricting its size. In contrast, presented in the newly proposed way, the full size of a given display can be used to depict the meaning of the graphical symbol, allowing it to become much larger as usual, to the effect that the specific topic of a danger or prohibition can be comprehended from greater distance and thereby much earlier⁶.

According to this previous evaluation it can be rightly expected that this would greatly enhance road safety.

2.3. Test Setting

The test setting was based on an animated simulation; the test series were driven by a pre-programmed flash-movie. Test persons were seated in front of a screen projection to simulate a driving situation. The distance to the screen (viewing distance) and the size of the presented pictogram were carefully balanced. The chosen pictogram size was aimed to allow for the discrimination of small graphical detail.

Each (animated) pictogram was shown for exactly 3.3 seconds⁷, which is the time between the first clear comprehension of the pictogram to the moment of disappearance at a velocity of 100 km/h.

The basic conditions of the test setting are shown within figure 1.

Technical settings

Projector resolution 1024x768

PC Screen resolution 1024x768

Physical settings

Projection area (AxB): 213cm x 165cm

Animation display area (C): 25cm x 25cm

Distance projection area – floor (D): 60cm

Viewing distance (E): 255.6cm (=231x1.2)

⁶ See Brugger, C. (2006): Evaluation of Warning Elements for Matrix Displays; Report In-Safety, 506716. 31/10/2006.

⁷ One exception: switch off engine, congestion warning.

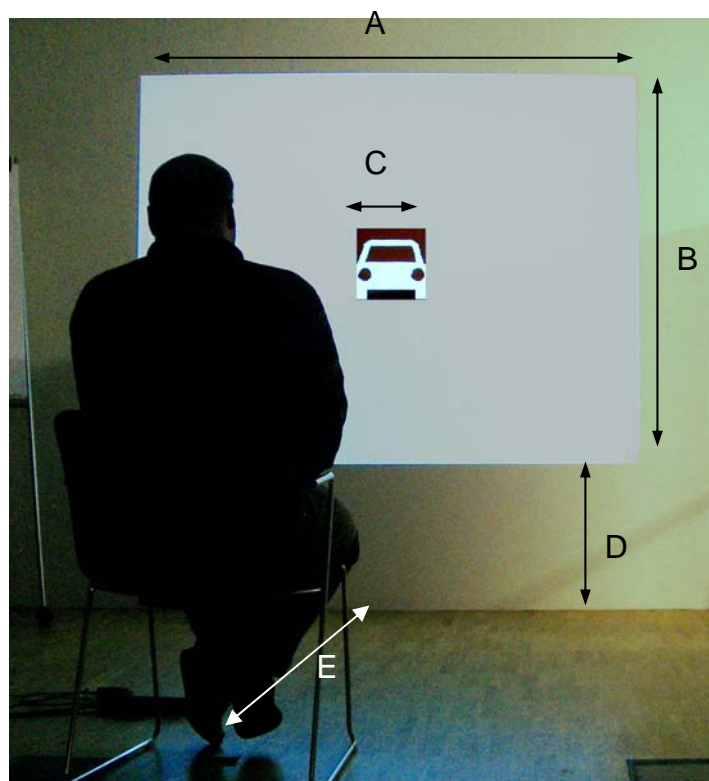























Figure 1: Physical Settings for the Test of Animated Pictograms, source: authors















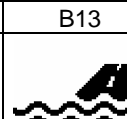
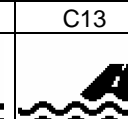

2.4. Referents

The referents were split into three different series in order to ensure reliable testing. Twelve referents (in 20 variants) were tested. Each series consisted of nine different animated pictograms. Additionally, two static pictograms were included into each series in order to elaborate the influence of animation on the comprehension of pictograms and compare comprehension rates between static and animated pictograms.

The following table 1 shows the assignment to the series.

Table 1: Test of Animated Pictograms: Assignment of Referents to Series

Animated Pictograms							
Code	Referent	Referent Name	Variants	Series A	Series B	Series C	Basis pictogram
				A1/x	B1/o	C1/02	
1	1-2-1-2	Closure ahead: Pass	3				
					B2		
2	3-1-3	Speed camera	1				
				A3/o	B3/o	C3/o	
3	1-2-1-3	Closure ahead: Tunnel	3				
				A4	B4	C4	
4	1-2-1-4	Closure ahead: Bridge	3				
				A5/x	B5/o	C5/o2	
5	1-4-1-5	Dedicated lanes: Emergency vehicles	3				
					B6/3eck		
6	2-3-3	Vehicle broken down	1				
				A7/3eck			
7	2-2-2	Fog	1				

							C8/3eck	
8	2-2-3	Freezing fog	1					
							C9	
9	4-5	Switch off engine/congestion	1					
				A10	B10	C10		
10	2-3-4	Oncoming illegal traffic	3					
				A11		C11		
11	2-3-4	Accident (has happened) (static version)	1					
				A12	B12			
12	1-2-1-5	Closure ahead: Next exit (static version)	1					
				A13	B13	C13		
13	2-2-1	Flooded road (static version)	1					

2.5. Testing

Each participating organisation –Danube University Krems (DUK) and Centrum dopravného výzkumu (CDV) –conducted the test with at least 50 respondents for each series. Overall 150 respondents (per organisation) had been invited.

The supervisors were instructed that the sample of respondents should resemble the driving population in terms of age, sex, and educational level. Persons with severe visual impairment (no correction possible) were not allowed to take part. The sample should preferably consist of respondents who were expected to be familiar with the referents. Therefore, only participants holding a driving licence were employed.

Upfront, the participants were given a verbal instruction. Additionally, each animation was preceded by a written introduction. As shown in figure 1, participants sat in front of a screen, simulating the driver's position.

A total number of nine pictograms had to be judged by each participant. After each shown animation respondents were asked to declare what they think the symbol meant and what action they would take in response to it.

2.6. Participants

Two countries (Austria, the Czech Republic) participated in the test with 158 participants in Austria and 150 participants in Czech Republic. In sum, 308 respondents (206 male, 102 female) evaluated the CAT.

Only persons holding a driving licence were invited to the test. Due to the high amount of male participants within the Czech test series, gender equality was not reached within that test series. But overall a resemblance of the test sample with the driver population in terms of age, educational level, and driving experience was achieved.

Detailed sample characteristics are shown in table 2.

Table 2: Respondents Statistics

	Austria	Czech Republic	Total	Total Means and Values
Respondents	158	150	308	
Average age (in years)	31	43	37	
Gender				
Men	71	135	206	67%
Women	87	15	102	33%
Educational Level				
Primary	23	56	79	26%
Secondary	97	94	191	62%
University	38	1	39	13%
Unknown	0	0	0	0%
Driving Experience				
Average distance (km)/year	15396,66	35320		25358,33
Years	12,14	22		17,07

2.7. Analysis

Analysis of the CT involved three independently working judges, who assigned each response to one of the following seven standard categories:

- Cat.1.: Correct understanding of the symbol is certain
(Estimated probability of correct understanding over 80%)
- Cat.2.: Correct understanding of the symbol is very probable
(Estimated probability of correct understanding between 66 and 80%)
- Cat.3.: Correct understanding of the symbol is probable
(Estimated probability of correct understanding between 50 and 65%)
- Cat.4.: The meaning which is stated is the opposite of that intended
- Cat.5.: Any other response
- Cat.6.: The response given is "Don't know"
- Cat.7.: No response is given

An overall score for each variant is obtained by weighing and summing the percentages of responses in the different categories. The variant with the highest overall score is the most comprehensible variant.

As there is no further specific score determination within the current ISO Standard, the analysis on the results follows the criteria according to ISO 9186 (first edition 1989)⁸, which foresees the following evaluation scheme:

"If the comprehension score for this variant exceeds 66, then this variant may be used to define the standard image content.

Where two variants have the same comprehension score, the most comprehensible variant can be identified by taking the one having the lowest percentage of responses in category 5 ("the response is wrong").




For critical referents (e.g. safety symbols) the 66 criterion shall be rigorously adhered to.

For less important referents the criterion may be relaxed by including category 3 responses in the cumulative value in order to comply with the 66 criterion"

⁸ ISO, International Standardization Organization (1989): ISO 9186: First Edition, Procedures for the development and testing of public information symbols. Geneva: ISO.

3. RESULTS OF THE COMPREHENSION OF ANIMATED PICTOGRAMS TEST

1.2.1.2: Closure ahead: pass

Variant	Animation	
A		
B		
C		

Austria	A			B			C		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	4	8	7,5	0	0	0	8	16	15,7
Very probable	9	18	12,7	0	0		5	10	7,4
Probable	10	20	9,4	0	0		6	12	5,9
Opp. meaning	7	14	-13,2	1	2,3	-1,9	7	14	-13,7
Wrong	19	38	0	43	97,7		23	46	
Don't know	1	2	0				1	2	
No response									
Total	50	100	16,5	44	100	-1,9	50	100	15,2
Czech Republic	A			B			C		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	21	42	42	13	26	26	6	12	12
Very probable	2	4	3	4	8	6	0	0	0
Probable	3	6	3	0	0	0	0	0	0
Opp. meaning	16	32	-32	28	56	-56	40	80	-80
Wrong	8			4			3		
Don't know				1			1		
No response									
Total	50	84	16	50	90	-24	50	92	-68

Overall score	A 16,25	B -12,95	C -26,4
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Most frequent responses⁹			
	A	B	C
Category 1	pass closed	mountain road is impassable	driving ban into the curves
	pass, curves, forbidden to drive	driving ban in the mountain pass	zigzag road, no stopping (no entry)
Category 2	no entry in the road with the curves	ban of traffic	
Category 3	zigzag road, increased risk by passage	zigzag road	
		double beds, decelerate	
Category 4	dangerous curves	end of the zigzag road	attention curves
	double bends - attention	End of mountain road	zigzag road
		Not curvy street.	road in the mountains, no waiting
Category 5	danger of skidding	mountain pass transit	attention danger
	serpentine	danger of skidding	the river
		Curvy road	no pull up the vehicle
		Serpentine	attention curves

The animated versions of the referent show three different “closure” elements, which are superimposed on the referent:

Variation A depicts a red cross as a symbol for “closure”, variation B shows a red circle (according to the Vienna Convention's¹⁰ sign for traffic prohibition) and variation C presents a red circle with a slanted line through the middle (also according to the Vienna Convention).


The answers show that the element “pass ahead” had not been comprehended, indicating “zigzag road, increased risk to pass, and dangerous curves”. But also a high level of answers had to be categorized as “opposite meaning” within all three pictograms (A: 23; B: 31; C: 47), which leads to the assumption that the “prohibition” elements, within all three pictograms had not been recognized.

Of the three tested variants, variation A reached the highest ISO score of 16,25. The scoring within both testing groups was comparable for this referent.

⁹ Both from Austria as well as from the Czech Republic

¹⁰ United Nations; Economic and Social Council; Economic Commission for Europe; Inland Transport Committee (1968): “Vienna Convention: Convention on Road Signs and Signals”, Vienna.

3.1.3 Speed Camera

Variant	Animation
B	

Austria	B		
Category	f	%	Score
Certain	47	94	88,7
Very probable	1	2	1,4
Probable			
Opp. meaning			
Wrong	1	2	
Don't know	1	2	
No response			
Total	50	100	90,1
Czech Republic	B		
Category	f	%	Score
Certain	50	100	100
Very probable			
Probable			
Opp. meaning			
Wrong			
Don't know			
No response			
Total	50	100	100

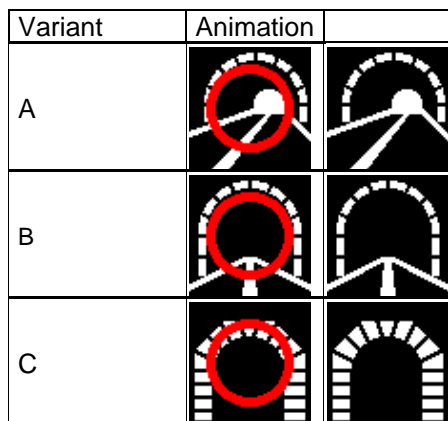
Overall score	B	95,05
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Most frequent responses	
	B
Category 1	radar speed control
	radar
	speed camera
	speed measurement
	radar speed control
Category 2	-
Category 3	-
Category 4	-
Category 5	-

This referent reached the ISO score of 95,05. According to ISO score rating, this referent is approved.

Compared to the results of the CJT, where this variant reached a median score of 98,6, which was the highest score for that referent, the animation does not impair comprehension.

1.2.1.3 Closure ahead: tunnel



Austria	A			B			C		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	5	10,6	10,6	0	0	0	14	28,6	28,6
Very probable	0						0	0	0
Probable	0			0			1	2,04	1,02
Opp. meaning	38	80,85	-80,8	47	95,91	-95,9	21	42,86	-42,9
Wrong	3			2			11		
Don't know	1			0			2		
No response									
Total	47		-70,2	49		-95,9	48		-13,3
Czech Republic	A			B			C		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	22	44	44	20	40	40	21	42	42
Very probable	0	0	0	0	0	0	0	0	0
Probable	1	2	1	1	2	1	0	0	0
Opp. meaning	26	52	-52	26	52	-52	27	54	-54
Wrong	1			3			2		
Don't know							0		
No response									
Total	50		-7	50		-11	50		-12
Overall score		A	-38,6		B	-53,4		C	-12,6

Most frequent responses			
	A	B	C
Category 1	tunnel - ban of traffic	ban of traffic into the tunnel	driving ban into the tunnel
	tunnel is closed	tunnel - ban of traffic	tunnel, driving ban
		tunnel is closed	ban of traffic into the tunnel
Category 2			
Category 3			Tunnel, red circle, prohibition, possible train tunnel
Category 4	tunnel - worsen transit	barrier in the tunnel	
	attention tunnel ahead	tunnel	attention tunnel
	Tunnel, entrance, turn on lights	entrance into the tunnel	entryway into the tunnel
		Turn on lights, reduce speed, Be careful with changing lighting conditions	Tunnel, reduce speed
Category 5	End of tunnel		To pass under a bridge
			Height of tunnel
			Low height of tunnel
			Door, entry

This animation shows three different variants of the referent tunnel, superimposed by a flashing red circle, indicating the closure of a tunnel.

All variants had not been comprehended well, and got a high percentage of answers within the opposite meaning category (around 50%), indicating that a “tunnel is ahead”, “turn on lights”, “reduce speed” or “be careful with changing lighting conditions”. The analyses showed that the tunnel symbol had been comprehended in all cases, but the closure symbol (red circle) was mentioned only a few times within the answers or reactions.

Only a few answers for both variants A / C rely on “red circle”, but being asked for the reaction they would take, participants stated that they would drive more carefully and slowly.

Variant C got also a high number of answers like “height of tunnel”, “drive carefully, low height of tunnel” and seems to be associated more with a narrow tunnel.

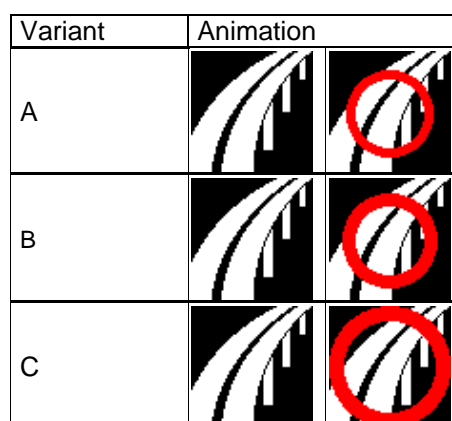
A second purpose to test this referents example was to find the most appropriate representation for a motorway tunnel today. While referent A is derived from Italian best practice, referent C’s appearance is governed by the Vienna Convention¹¹, and referent B is a new design, bearing elements of both A and C.

In comparison to previous performances in other tests, where A (example 1 in the CJT) scored a median of 68,8, while B (example 1 in CJT) reached 65 and C (4 in CJT) performed at 55,5, the animation seems to reduce the comprehension rate dramatically.

It has to be mentioned that variant C, despite being known by drivers, does not score well. Further investigation is advisable.

¹¹ United Nations; Economic and Social Council; Economic Commission for Europe; Inland Transport Committee (1968): “Vienna Convention: Convention on Road Signs and Signals”, Vienna.

1.2.1.4 Closure ahead: bridge



Austria	A			B			C		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	1	2,0	1,9	1	2,1	1,9	10	21,7	19,6
Very probable	2	4,1	2,8	0	0	0	0	0	0
Probable	3	6,1	2,8	0	0	0	2	4,3	2,0
Opp. meaning	24	49,0	-45,3	23	48,9	-43,4	11	23,9	-21,6
Wrong	18	36,7		21	44,7		23	50	
Don't know	1	2,0		2	4,3		0	0	
No response									
Total	49	100	-37,7	47	100	-41,5	46	100	0
Czech Republic									
	A			B			C		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	22	44,0	44,0	18	36,00	36,00	19	38,00	38,00
Very probable	1	2,0	1,50	0	0,00	0,00	0	0,00	0,00
Probable	0	0,0	0,0	1	2,00	2,00	1	2,00	2,00
Opp. meaning	15	30,0	-30,0	23	46,00	-46,00	20	40,00	-40,00
Wrong	12	24,0		8	16,00		10	20,00	
Don't know									
No response									
Total	50	100	15,50	50,00	100	-8,00		100	0

Overall score	A	-22,2	B	-49,5	C	0
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Most frequent responses			
	A	B	C
Category 1	bridge - ban of traffic	bridge - ban of traffic	ban of traffic over the bridge
	the bridge is closed	ban of traffic into the bridge	bridge impossible to drive
		bridge - no entry	bridge, no drive into
			bridge is closed
Category 2	roadblock on the bridge		
Category 3		barrier on the bridge	Accident on the bridge, bridge is closed
Category 4	Bridge, go straight on	Bridge, drive on	Bridge, drive carefully
	driving over the bridge	highway bridge	Bridge, drive on, slow speed
	attention bridge ahead	no waiting on the bridge	
Category 5	Side winds on bridge	motorway	bridge - hoarfrost, side wind
	Speed reducing on bridge	bridge - jeopardy of side wind	bridge, danger of ice
	motorway		bridge, attention glazed frost
			drive on the motorway







This referent showed a bridge on a motorway, the closure was symbolized by three distinct red circles: variant A depicted a small, thin circle, variant B showed a small circle bearing a wide stroke, and variant C again depicted a large circle with a wide stroke, which was superimposed over the pictogram.

The analysis shows that the bridge itself as a symbol had been comprehended well; almost all of the answers mention the word "bridge" first. Nevertheless none of the closure elements was comprehended well. The blinking, superimposed circle is not recognized and mentioned by the highest number of participants, which can be seen from the high number of "Opposite Meaning answers": Variant C received the lowest number of answers within the category "opposite meaning" in Austria (11 answers), whereas in Czech Republic variant B received the lowest number of answers within this category (23 answers). The answers rely on "attention, there is a bridge ahead", "Slow down, bridge ahead". The mentioned action in that case was "drive on, reduce speed, and be careful".

Within category 5 (wrong answers) answers refer to certain circumstances related to driving over a bridge, like side winds possible, glazed frost, or danger on ice.

The analysis leads to the assumption that the tested superimposed prohibition elements are not comprehended. The size of the flashing elements varied within these three variants, but did not allow for significant differences within the comprehension rates.

1.4.1.5 Dedicated lanes for emergency vehicles

Variant	Animation	
A		
B		
C		

Austria	A			B			C		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	6		11,3	5	9,4	9,4	12	25	23,5
Very probable	2		2,8	2	2,8	2,8	1	2,1	1,5
Probable	30		28,3	30	28,3	28,3	20	41,7	19,6
Opp. meaning	6		-11,3	0	0	0	0	0	0
Wrong	7			13	24,5		11	22,9	
Don't know	2			3	5,7		4	8,3	
No response									
Total	53	100	31,1	53	100	40,6	48	100	44,6
Czech Republic	A			B			C		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	9	18	18	10	20	20	15	30	30
Very probable	18	36	27	19	38	28,5	24	48	36
Probable	2	4	2	8	16	8	0	0	0
Opp. meaning	5	10	-10	2	4	-4	2	4	-4
Wrong	16			9			7		
Don't know				2			2		
No response									
Total	50	68	37	50	78	52,5	50	82	62
Overall score	A	34,05		B	46,55		C	53,3	


Most frequent responses			
	A	B	C
Category 1	Car with priority	Emergency car with priority, I enable the thoroughfare	give way to emergency vehicles
		allow passage for cars with priority	no drive this traffic lane
			car with the right of way, give way
Category 2	Possibility of emergency car	Possibility of emergency car	Possibility of emergency car
		Attention, emergency car	car with the beacon, no waiting
		attention, rescue vehicle or police car	Attention, emergency car
Category 3	possible accident	the motor road is closed	way out of ambulance cars, no waiting here
	non-passable traffic lane	ambulance exit	
		no transit	
		ambulance way out	
Category 4	forbidden for cars with traffic priority	forbidden for emergency cars	forbidden for emergency cars
Category 5			

To explore the possibility of dedicating a lane to a specific road user (emergency vehicle), the closure elements here were alternating, superimposing a red cross (variant A), a red circle (variant B) and a red circle with a stroke (variant C).

The pictogram itself showing an emergency car was comprehended well within all three variants.

According to the analysis, the respondents showed a preference for variant C's "traffic prohibited"-element, which is governed by traffic regulations. It got the highest numbers of "certain answers" within both testing groups, it is scored with 53,3.

2.3.3 Vehicle broken down

Variant	Animation
B	

Austria	B		
Category	f	%	Score
Certain	40	76,9	75,5
Very probable			
Probable	2	3,8	1,9
Opp. meaning			
Wrong	10	19,2	
Don't know			
No response			
Total	52	100	77,4
Czech Republic	B		
Category	f	%	Score
Certain	35	70	70
Very probable	1	2	1,5
Probable	2	4	2
Opp. meaning	2	4	-4
Wrong	9		
Don't know	1		
No response			
Total	50	80	69,5

Overall score	B	73,45
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Most frequent responses	
	B
Category 1	vehicle broken down
	broken car on the road
	immobile vehicle on the road
Category 2	car repair - make use warning triangle
Category 3	engine fire
	engine failure
Category 4	car engine repairs prohibition
	no repair vehicles
Category 5	engine overheating

The animation of the referent shows a broken down vehicle, the front lid is open, and symbolizes engine problems, superimposed by a flashing danger warning triangle.

Compared to the performance of this example in the 1st CT (21,4), the addition of curved lines, symbolizing smoke or heat emitting from the car's hood, as well as the danger triangle, has proven great positive effect.

This referent was comprehended well within both testing groups. Picture content is approved.

2.2.2 Fog

Variant	Animation
A	

Austria		A		
Category	f	%	Score	
Certain	23	51,1	43,3	
Very probable	1	2,2	1,4	
Probable	1	2,2	0,9	
Opp. meaning				
Wrong	16	35,6		
Don't know	4	8,9		
No response				
Total	45	100	45,8	
Czech Republic		A		
Category	f	%	Score	
Certain	30	60	60	
Very probable	6	12	9	
Probable	2	4	2	
Opp. meaning		0	0	
Wrong	9			
Don't know	3			
No response				
Total	50	76	71	

Overall score	A	58,4
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Most frequent responses	
	A
Category 1	fog
	attention fog
	fog, poor visibility
Category 2	reduced visibility
Category 3	Attention, reduce speed, reduced visibility
	Attention rain
Category 4	-
Category 5	Attention side winds
	Aquaplaning
	Icy street


On this referent, a danger warning triangle was superimposed and was tested within one series. The analysis shows, that the symbol of a car disappearing in the fog was comprehended by more than 50 % of the participants.

The wrong answers (around 25 answers had been categorized wrong) rely to different weather conditions like "side winds", "aquaplaning", or "icy street".

However, the answers concerning the reaction to this symbol like "reduce speed", "reduced visibility, drive carefully" show that the context of the symbol has been comprehended.

The referent reached the score of 58,4, which allows for acceptance, but in comparison to the static version (tested within the Comprehension Test, scored at 80,8) the rate of the animated series is much lower.

2.2.3 Freezing Fog

Variant	Animation
C	

Austria	C		
Category	f	%	Score
Certain	14	29,8	27,5
Very probable	7	14,9	10,3
Probable	22	46,8	21,6
Opp. meaning	0	0	
Wrong	3	6,4	
Don't know	1	2,1	
No response			
Total	47	100	59,3
Czech Republic	C		
Category	f	%	Score
Certain	16	32	32
Very probable	30	60	45
Probable	3	6	3
Opp. meaning		0	0
Wrong	1		
Don't know			
No response			
Total	50	98	80
Overall score		C	69,65

Most frequent responses	
	C
Category 1	attention glazed frost
	attention, glazed frost, danger of skid
Category 2	danger of ice accretion
	danger of skidding
	danger of skidding, be careful
Category 3	very slow drive
	smog or fog
	weather conditions impaired
Category 4	
Category 5	police car or ambulance

The animated referent of "freezing fog", superimposed by a flashing danger triangle, reached an ISO Score of 69,65. Picture content is approved. This performance is virtually as high as its score in the Comprehension Test (variant A, 71,3).

4.5 Switch off engine

Variant	Animation
C	

Austria	C		
Category	f	%	Score
Certain	23	60,5	45,1
Very probable	1	2,6	1,5
Probable	3	7,9	2,9
Opp. meaning	0	0	0
Wrong	6	15,8	
Don't know	5	13,2	
No response			
Total	38	100	49,5
Czech Republic	C		
Category	f	%	Score
Certain	25	50	50
Very probable	0	0	0
Probable	2	4	2
Opp. meaning		0	0
Wrong	14		
Don't know	9		
No response			
Total	50	54	52

Overall score		C	50,75
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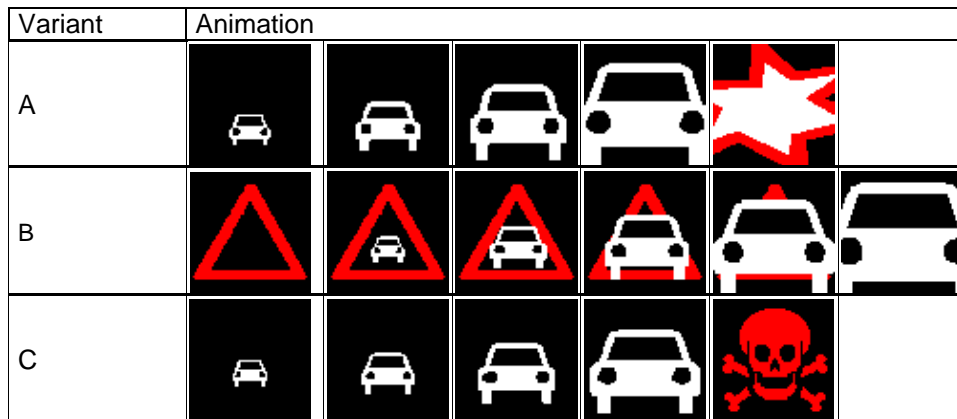
Most frequent responses	
	C
Category 1	switch off engine
	danger of smog, switch off engine
Category 2	
Category 3	lay up the car
	by car abandonment switch off engine
Category 4	
Category 5	jeopardy
	attention, the car is not the strongbox
	lock up the car
	Defect vehicle; lock the vehicle and repair it
	traffic restriction for vehicles contaminating environment

This was the only referent shown longer than 3.3 seconds during the test simulation, since it will only be presented to drivers in traffic jam situations, where traffic has (almost) stopped.

The symbol was comprehended well, although the association to the context of the sign "congestion" was not referred to very often by the participants. On the other hand the mentioned reactions agree with the meaning of the sign. Wrong answers (around 20 within both testing groups) stress the term of "accident or defect vehicle".

The static representation of this referent was tested in the CT, where it reached 63,6 for variant B which reached top score at that time. This time the animated version rated with 50,75, which is sufficient for approving the picture content, but not as high as the static version.

2.3.4 Oncoming illegal traffic



Austria	A			B			C		
	f	%	Score	f	%	Score	f	%	Score
Certain	11	21,6	20,8	15	31,3	28,3	14	28,6	27,5
Very probable	0	0							
Probable	8	15,7	7,5	22	45,8	20,8	8	16,3	7,8
Opp. meaning	0	0							
Wrong	30	58,8		8	16,7		27	55,1	
Don't know	2	3,9		3	6,3				
No response									
Total	51	100	28,3	48	100	49,1	49	100	35,3
Czech Republic									
Czech Republic	A			B			C		
	f	%	Score	f	%	Score	f	%	Score
Certain	6	12	12	13	26	26	11	22	22
Very probable	1	2	1,5	0	0	0	0	0	0
Probable	15	30	15	6	12	6	10	20	10
Opp. meaning	0	0	0	0	0	0	0	0	0
Wrong	25			29			25		
Don't know	3			2			4		
No response									
Total	50	44	28,5	50	38	32	50	42	32
Overall score									
		A	28,4		B	40,55		C	33,65

Most frequent responses			
	A	B	C
Category 1	attention, oncoming vehicle	ghost driver	road pirate in the opposite direction
	jeopardy of collisions with the oncoming cars	attention, oncoming cars	attention, oncoming vehicles
	ghost driver	jeopardy - oncoming cars	oncoming vehicle
Category 2			
Category 3	approaching car	two way traffic	two way traffic
Category 5	jeopardy of accident	attention jeopardy	jeopardy of collision
	attention tailback, to keep the safe distance	certain warning	danger of accident
	aquaplaning, danger of skidding	car on the road	danger of collision
	Congestion ahead	give way	dangerous goods
	danger of rear-end-collisions	tailback formation	speed control
		accident ahead, attention	attention accident
			danger zone

All three variants of the referent “oncoming illegal traffic” had been newly designed for this test series.

Variant A reached the lowest score of the three tested variants (28,4). The answers of half of the participants (55 persons) have been categorized “wrong”, because of mentioning the terms “accident, drive slowly”, “danger of rear-end-collisions”, “tailbacks ahead”.


Variant B reached the best score (40,55). The red triangle was often categorized as warning symbol. The wrong answers rely on “danger of accident”, “danger of collision, or “tailbacks ahead”.

Variant C utilizes a skull, it reached the score of 33,65. Answers for this variant often stress the term of “danger” often in combination with “dangerous goods” or “attention”.

Comparison between the static and the animated version shows that the variants tested within the CT scored significantly lower (Var. A 14,0 – Var. B. 20,0 – Var. C. 16,2 – Var. D. 22,0), an improvement was reached. As none of the animated versions were tested as a static representation within the CT as well, the influence of the animation cannot be verified.

As the meaning of the referent seems to be very difficult to comprehend, it is recommended that this referent should be announced before introduction to be learned by the driving population.

2.3.2: Accident has happened

Variant	Static
A+C	

Austria	A			C			Mean		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	36	70,6	70,6	31	72,1	72,1	67	67,0	67,0
Very probable	8	15,7	11,8	3	7,0	5,2	11	11,0	8,3
Probable	7	13,7	6,9	8	18,6	9,3	15	15,0	7,5
Opp. meaning	0	0,0	0,0		0,0	0,0	0	0,0	0,0
Wrong	0			0			0		
Don't know	0			1			1		
No response							0		
Total	51		89,2	43		86,6	94		88,0
Czech Republic	A			C			Mean		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	35	70,0	70,0	36	72,0	72,0	71	71,0	71,0
Very probable	5	10,0	7,5	5	10,0	7,5	10	10,0	7,5
Probable	7	14,0	7,0	1	2,0	1,0	8	8,0	4,0
Opp. meaning	0	0,0	0,0		0,0	0,0	0	0,0	0,0
Wrong	2			2			4		
Don't know	1			2			3		
No response							0		
Total	50		84,5	46		80,5	96		82,5


Overall score	A	86,85		C	83,55	Mean		85,25
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Most frequent responses	
	A+C
Category 1	Accident happened
	Accident ahead
	Accident on the road
	Point of traffic accident
	Accident happened
Category 2	Attention, high accident frequency
	Accident, overturned car
	Accident stage
	Frequent accidents in this stage
	Attention, high accident frequency
Category 3	Dangerous bend
	Unsafe shoulder
Category 5	Danger of skidding
	Attention side wind
	Slippery road
	Side winds
	Danger of turning over the car

This pictogram was presented in its static version in order to compare the rates of comprehension to those of the 2nd CT in Paper and Pencil version before.

This pictogram improved after the redesign from the 1st CT (52.7) to 65,3 within the 2nd CT. Within this test, the pictogram was shown in the static version, but it was presented through a different medium (projected onto a wall), the score improved to 85,25.

1.2.1.5: Next exit closed

Variant	Static
A+B	


Austria	A			B			Mean		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	19	38,8	38,8	16	31,4	31,4	35	35,0	35,0
Very probable	4	8,2	6,1	5	9,8	7,4	9	9,0	6,8
Probable	24	49,0	24,5	26	51,0	25,5	50	50,0	25,0
Opp. meaning		0,0	0,0	1	2,0	-2,0	1	1,0	-1,0
Wrong	1			2			3		
Don't know	1			1			2		
No response							0		
Total	49		69,4	51		62,3	100		65,8
Czech Republic	A			C			Mean		
Category	f	%	Score	f	%	Score	f	%	Score
Certain	41	82,0	82,0	42	84,0	84,0	83	83,0	83,0
Very probable	3	6,0	4,5	0	0,0	0,0	3	3,0	2,3
Probable	3	6,0	3,0	4	8,0	4,0	7	7,0	3,5
Opp. meaning		0,0	0,0		0,0	0,0	0	0,0	0,0
Wrong	3			4			7		
Don't know							0		
No response							0		
Total	50		89,5	50		88,0	100		88,8

Overall score					Mean		77,3
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Most frequent responses	
	A+C
Category 1	Next exit closed
	Closed exit to the right
	Exit closed
	Next exit closed
Category 2	Street on the right is ending
Category 3	Blind alley
	Junction is blind alley
	Dead end street on the right
	Dead end street, driving through forbidden
Category 4	-
Category 5	Emergency escape exit to the right
	Speed bump
	Crossing with dead end street
	Stopping distance
	Street is diverted here

This pictogram, which originates from the Vienna Convention, was presented in its static version in order to compare the rates of comprehension to those of the Paper and Pencil Tests before. Results (77,3) are equivalent to the score of variant A in the 1st CT (74,0).

2.2.1: Flooded road

Variant	Static
A	

Austria	A			B			C			Mean		
Category	f	%	Score	f	%	Score	f	%	Score	f	%	Score
Certain	34	70,8	70,8	35	68,6	68,6	29	60,4	60,4	98	66,7	66,7
Very probable	3	6,3	4,7	0	0,0	0,0	5	10,4	7,8	8	5,4	4,1
Probable	3	6,3	3,1	8	15,7	7,8	5	10,4	5,2	16	10,9	5,4
Opp. meaning	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0
Wrong	8			7			7			22		
Don't know				1			2			3		
No response										0		
Total	48		78,6	51		76,5	48		73,4	147		76,2
Czech Republic	A			B			C			Mean		
Category	f	%	Score	f	%	Score	f	%	Score	f	%	Score
Certain	42	84,0	84,0	34	68,0	68,0	38	76,0	76,0	114	76,0	76,0
Very probable	1	2,0	1,5	0	0,0	0,0	0	0,0	0,0	1	0,7	0,5
Probable	5	10,0	5,0	5	10,0	5,0	1	2,0	1,0	11	7,3	3,7
Opp. meaning	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0
Wrong	2			10			10			22		
Don't know				1			1			2		
No response										0		
Total	50		90,5	50		73,0	50		77,0	150		80,2











Overall score					Mean		78,2
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Most frequent responses	
	A+B+C
Category 1	Water on the road
	Flooded road
	Diluvial area
Category 2	Bad road negotiability
Category 3	Impaired driving conditions due to rainfall
	Interrupted road
	Obstacles on the road
Category 4	-
Category 5	Muddy road surface
	Road bumpiness
	Rough crossing






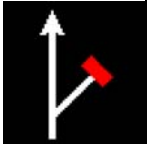
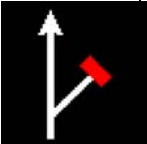



This variant entailed a comparable score as in the 1st CT (78,2), therefore picture content is approved.

4. DISCUSSION AND CONCLUSION

Table 3: Conclusions, Final Scores of the Tested Pictograms

Animated Pictograms							Iso Score			Suggestions
Code	Referent No.	Referent Name	no of variants	Serie A	Serie B	Serie C	Serie A	Serie B	Serie C	
				A1/x	B1/o	C1/o2				
1	1-2-1-2	Closure ahead: Pass_anim.	3				16,25	-12,95	-26,4	"forbidden" element was not comprehended well
					B2					
2	3-1-3	Speed camera_anim.	1					95,5		picture content approved
				A3/o	B3/o	C3/o				
3	1-2-1-3	Closure ahead: tunnel_anim.	3				-38,6	-53,45	-12,63	"forbidden" element was not comprehended well
				A4/o	B4	C4				
4	3-2-2-5	Closure ahead: bridge_anim.	1				-4,77			"forbidden" element was not comprehended well
				A5/x	B5/o	C5/o2				

5	1-4-1-5	Dedicated lanes for emergency vehicles	3							"forbidden" element was not comprehended well
					B6/3eck		34,05	46,55	53,3	
6	1-3-3	Vehicle broken down	1							picture content approved
				A7/3eck				73,45		
7	2-2-2	Fog_anim.	1							
						C8/3eck	58,4			
8	2-2-3	Freezing fog_anim.	1							picture content approved
						C9			69,65	
9	4-5	Switch off engine / congestion_anim.	1							
				A10	B10	C10			50,75	

10	2-3-4	Oncoming illegal traffic_anim.	3				28,4	40,55	33,65	difficult context, recommended to be advertised before displaying it.
				A11		C11				
11	2-3-2	Accident has happened_static	1				85,25			picture content approved
				A12	B12					
12	1-2-1-5	Next exit closed_static	1				77,3			picture content approved
				A13	B13	C13				
13	2-2-1	Flooded road_static	1				78,2			picture content approved

A total of 13 referents (in 21 variants) had been tested in this CAT. The aim of the test was to investigate the influence of animation on the comprehension of the meaning (or message) of a pictogram. 5 referents scored higher than ISO Score 66, they were comprehended well in both testing countries, the picture content is according to ISO score rating approved.

In detail, generally three types of animation were employed:

1. **Static pictograms with superimposed danger or prohibition elements, creating a flashing appearance, shown within the following pictograms:**

1-3-3 "Vehicle broken down"

2-2-2 "Fog"

2-2-3 "Freezing fog"

2-3-4 "Oncoming illegal traffic"

1-4-1-5 "Dedicated lanes for emergency vehicles"

1-3-3 "Vehicle broken down"

The animation of the referent shows a broken down vehicle, the front lid is open, and symbolizes engine problems, superimposed by a flashing danger warning triangle.

Compared to the performance of this referent in the 1st CT (21,4), the addition of curved lines, symbolizing smoke or heat emitting from the cars hood, as well as the danger triangle has proven great positive effect.

The animation of this pictogram could improve the score up to 73,45.

2-2-2 "Fog"

On this referent, a danger warning triangle was superimposed and was tested within one series. The analysis shows, that the symbol of a car disappearing in the fog was comprehended by more than 50 % of the participants.

The referent reached the score of 58,4, which allows for acceptance, but in comparison to the static version (tested within the CT, scored at 80,8) the rate of the animated series is much lower.

2-2-3 "Freezing fog"

The animated referent of "freezing fog", superimposed by a flashing danger triangle, reached an ISO Score of 69,65, picture content is approved. This performance is virtually as high as its score in the CT (variant A, 71,3).

2-3-4 "Oncoming illegal traffic"

All three variants of the referent "oncoming illegal traffic" had been newly designed for this test series. Variant A reached the lowest score of the three tested variants (28,4).

Variant B reached the best score (40,55), the red triangle was often categorized as warning symbol. The comparison between static and animated version shows that the variants tested

within the CT scored significantly lower (Var. A 14,0 – Var. B. 20,0 – Var. C. 16,2 – Var. D. 22,0), an improvement was reached. As none of the animated versions were tested also as a static representation within the CT, the influence of the animation cannot be verified.

As the meaning of the referent seems to be very difficult to comprehend, it is recommended that this referent should be announced before introduction to be learned by the driving population.

1-4-1-5 “Dedicated lanes for emergency vehicles”

The pictogram itself showing an emergency car was comprehended well within all three variants. According to the analysis, the respondents showed a preference for variant C’s “traffic prohibited”-element, which is governed by traffic regulations. It got the highest numbers of “certain answers”, within both testing groups it scored with 53,3.

2. (Static) pictograms with a prohibition element, shown within the following pictograms:

1-2-1-2 “Closure ahead: Pass”

1-2-1-3 “Closure ahead: Tunnel”

3-2-2-5 “Closure ahead: Bridge”

On each shown variant of these referents, an element for “closure” was superimposed or alternated with the pictogram. The elements to indicate “closure” varied showing either a red cross as used today on VMS to signalize a closed lane, a red circle (according to Vienna Convention) or a red circle with a slant line through the middle (also governed by international traffic regulations).

All three referents of “closure” received a significant high amount of answers within the category “opposite meaning”. This leads to the assumption that the “closure elements” had not been comprehended, or had not even been recognized.

1-2-1-2 “Closure ahead: Pass”

The high level of answers with “opposite meaning” (on average 33 % per variant) indicates, that the closure elements in all three variants had not been comprehended. Answers like “zigzag road, increased risk to pass, and dangerous curves” lead to the assumption that the “closure” elements had not been recognized.

1-2-1-3 “Closure ahead: Tunnel”

The analysis showed that the symbol of tunnel had been comprehended in all cases, but the element of the closure (red circle) was mentioned only a few times within the answers. All three variants got a high percentage of answers within the opposite meaning category (around 50%),

indicating a “tunnel is ahead”, “turn on lights”, “reduce speed”, or “be careful with changing lighting conditions”.

3-2-2-5 “Closure ahead: Bridge”

The analysis shows that the bridge itself as a symbol had been comprehended well; almost all of the answers mention the word “bridge” first. Nevertheless, none of the closure elements was comprehended well. The blinking, superimposed circle is not recognized and mentioned by the majority of the group, which can be seen from the high number of “Opposite meaning” answers: In Austria variant C received the lowest number of answers within the category “opposite meaning” (11 answers), whereas in Czech Republic variant B received the lowest number of answers within this category (23 answers). The answers rely on “attention, there is a bridge ahead” or “Slow down, bridge ahead”. The mentioned action in that case was “drive on, reduce speed, and be careful”.

The analysis leads to the assumption that the superimposed prohibition elements were not comprehended. The size of the flashing elements varied within these three variants, but did not allow for significant differences in between the comprehension rates.

It seems that the blinking, superimposed closure elements had not been comprehended, or had not even been recognized by the participants. Thus, the negating element varied, it is not clear, which of the symbols was comprehended better. It will need further investigations in order to analyse the different variants, the duration of the animation and the size of a superimposed element.

3. Animated pictograms, consisting of picture frames shown in fast succession, to create a film to transport messages which can not be delivered by a static symbol, shown within the following pictograms:

3-1-3 “Speed camera”

4-5 “Switch off engine/congestion”

3-1-3 “Speed camera”

This referent reached the ISO score of 95,05. According to ISO score rating, it can be approved. Compared to the results of the CJT, where this variant reached a median score of 98,6, which was the highest score for that referent, the animation does not impair or improve comprehension.

4-5 “Switch off engine/congestion”

This was the only referent shown longer than 3.3 seconds during the test simulation, since it will only be presented to drivers in traffic jam situations, where traffic has (almost) stopped.

The symbol was comprehended well, although the association to the context of the sign “congestion” was not referred to very often by the participants.

The static representation of this variant was tested in the CT, where it reached 63,6 for variant B which reached top score at that time. This time the animated version rated with 50,75, which is sufficient for approving the picture content.

In both cases the animation did not improve the ISO Score, but worked well.

4. Static pictograms, in order to combine the ISO Score of Paper and Pencil tests to the Animation within this test:

2-3-4 "Accident has happened"

1-2-1-5 "Next exit closed"

2-2-1 "Flooded road"

The rates of all three shown static pictograms are comparable to the rates reached within the CT, which leads to the assumption that the way of displaying, as well as the test setting can be compared.

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