

Validation of a signalization scheme for road works at a roundabout (simulator study)



AGENTSCHAP
WEGEN & VERKEER



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Introduction

- European Commission: [1]
 - *"Calls on the Commission to ensure that road work sites are made safer through guidelines for designing and equipping sites [...];*
 - *Calls for guidelines, which should include proper signing, removal of original road markings [...]"*

Introduction

- Road works
 - Standard signalization schemes for road works
 - Six categories
 - Eg. 50 km/h < speed limit
≤ 90 km/h
 - ➔ At a roundabout
 - ➔ With traffic lights at the branches

Validation



Introduction

- Effectiveness of signalization depends on [2]

Sign detection



Sign readability



Sign comprehension



Introduction

- Research questions
 - Is the signalization *comprehensible*?
 - Is the behavior of the drivers *correct*?
 - Destination reached?

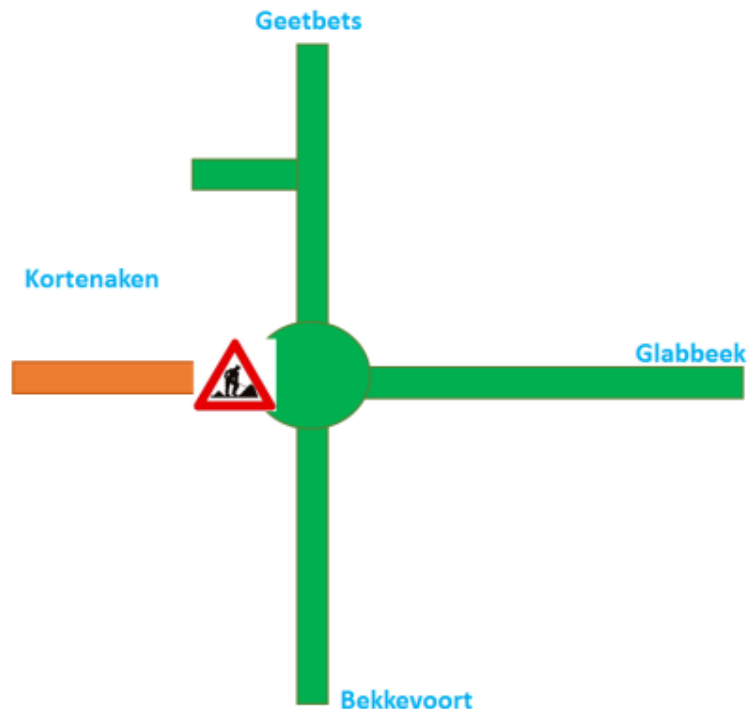


Method

Method

- Expert judgement
- Simulator
 - Fixed-based simulator
 - NADS MiniSimTM v2.0
- 7 experimental trips

Origin	Destination			
	South (Bekkevoort)	West (Kortenaken)	North (Geetbets)	East (Glabbeek)
South (Bekkevoort)	n/a	Route 1	Route 2	//
West (Kortenaken)	n/a	n/a	n/a	n/a
North (Geetbets)	Route 3	Route 4	n/a	Route 5
East (Glabbeek)	Route 6	Route 7	//	n/a



Instruction:

- *Drive as you normally do*
- Before every trip: *Go to ...*

Method

- Temporary signalization (the same for every branch)
 - Only during road works



Verkeersbord A33 + C43 op "raam"



Werfaankondiging



Verkeersbord C35



Verkeersbord C46 + F47



Verkeersbord A31 + onderbord 400m



Verantwoordelijke signalisatie

Method

- Temporary signalization (different for every branch)
 - Only during road works
 - Lane separation
 - Advance direction sign (100 m before temporary traffic light)
 - At 3-way intersection

Wegomlegging
diversion



F39 op zuidelijke tak
(komende uit Bekkevoort)



F39 op oostelijke tak
(komende uit Glabbeek)



F39 op noordelijke tak
(komende uit Geetbets) ty



- Specific signalization
 - Always present
 - Advance direction sign (200 m before roundabout)
 - 1 direction is occluded



F25 op zuidelijke tak
(komende uit Bekkevoort)



F25 op oostelijke tak
(komende uit Glabbeek)



F25 op noordelijke tak
(komende uit Geetbets)



Results & conclusion

Results and Conclusion

- 50 participants
 - 2 simulator sick → 48 participants

	Average	σ	Min.	Max.
Age [years]	37.9	16.9	20	69
Driving licence [years]	17.8	16.6	1	48
% male	62.5%			

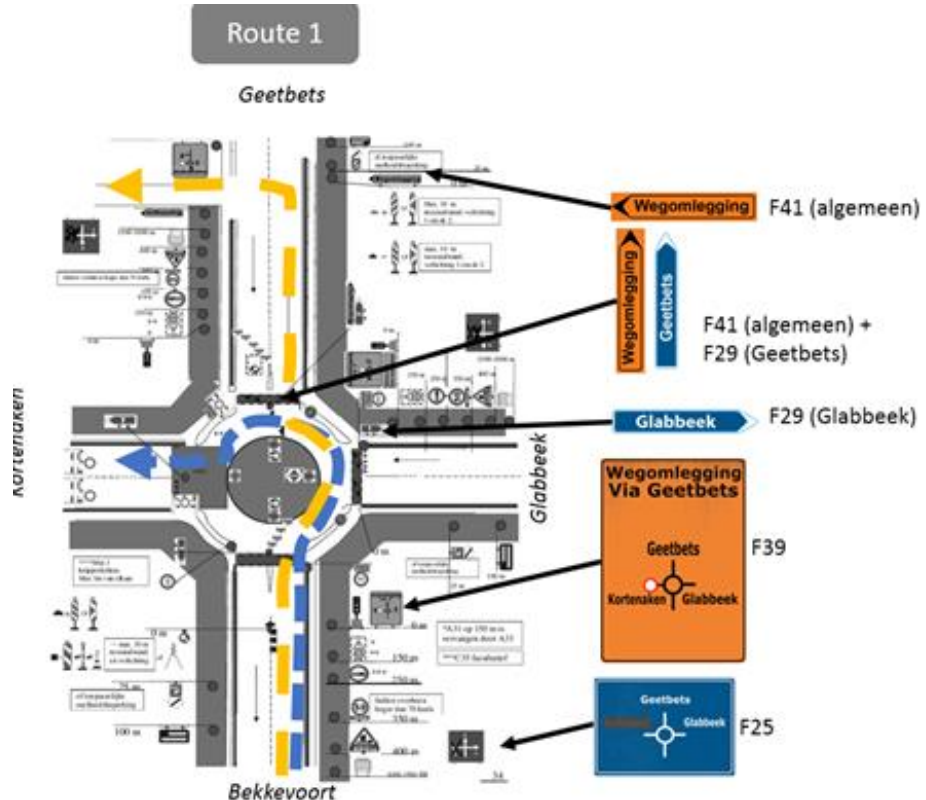
Results and Conclusion

- For each (7) route
 - Description of **'route without roadworks'** and **'route with roadworks'**
 - Analysis of driven route (Chi square test)
 - **Correct** ↔ **incorrect**
 - Recommendations

Route 1

Route 1: From south (Bekkevoort) to west (Kortenaken)

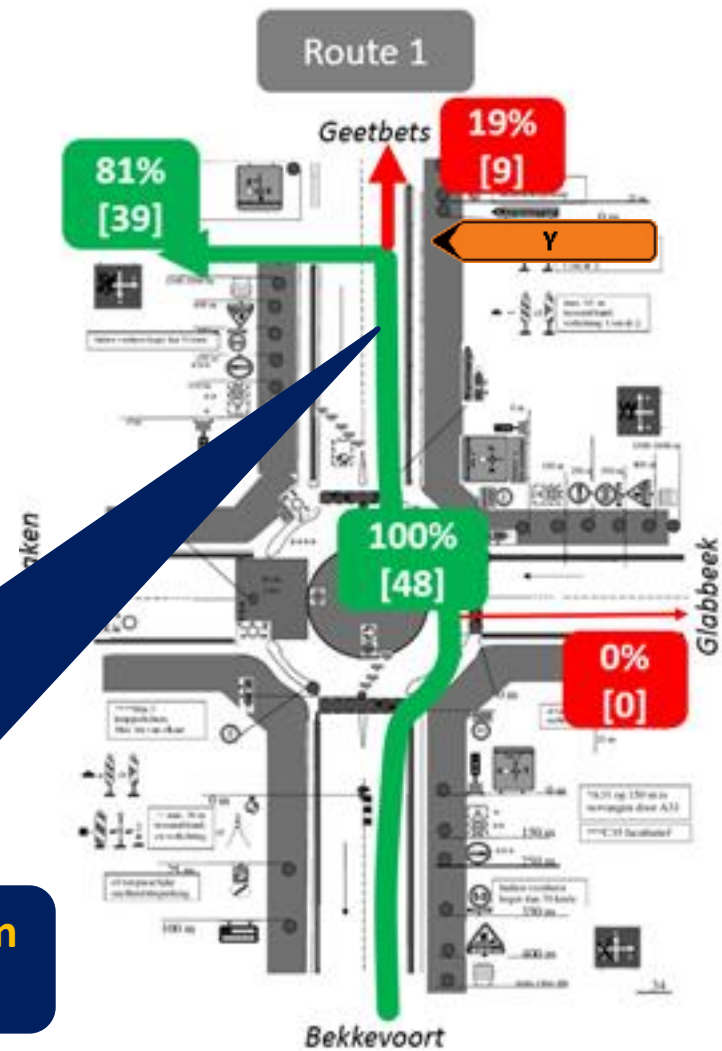
- **Without roadworks:** normal use of roundabout
- **With roadworks:** next three-way intersection



Route 1

- **19% incorrect** ($p < .0001$)
 - Straight on at 3-way intersection
- Recommendation ◀ Wegomlegging
 - Changing temporary *general* direction sign (diversion) by *specific* direction sign (city name)

Verbal comment of 78% of incorrect (7/9): **city name on temporary direction sign is better**

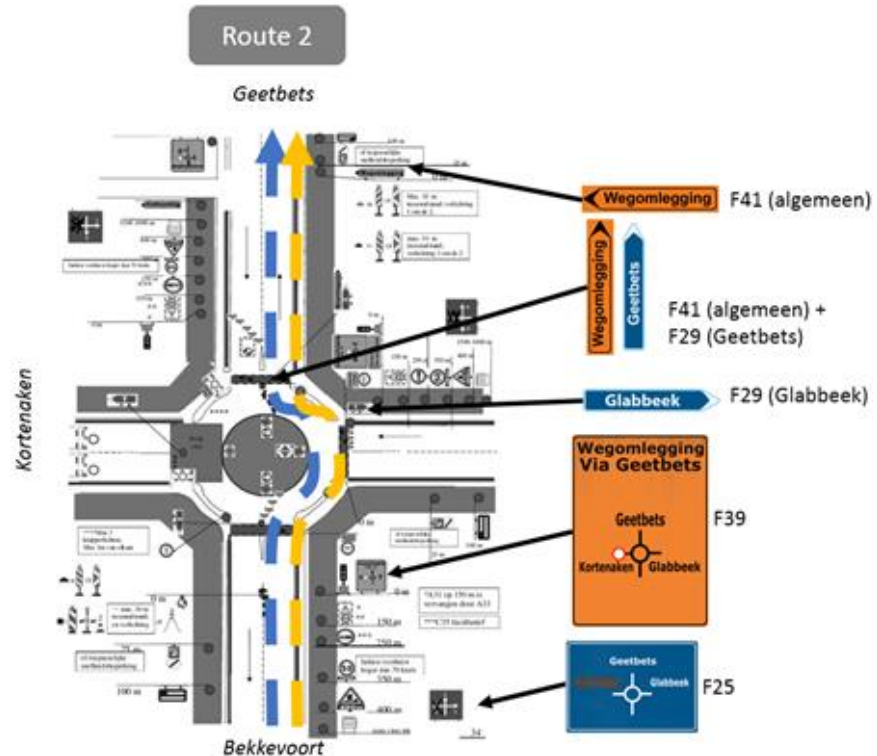


Route 2

Route 2: From south (Bekkevoort) to north (Geetbets)

- No differences:

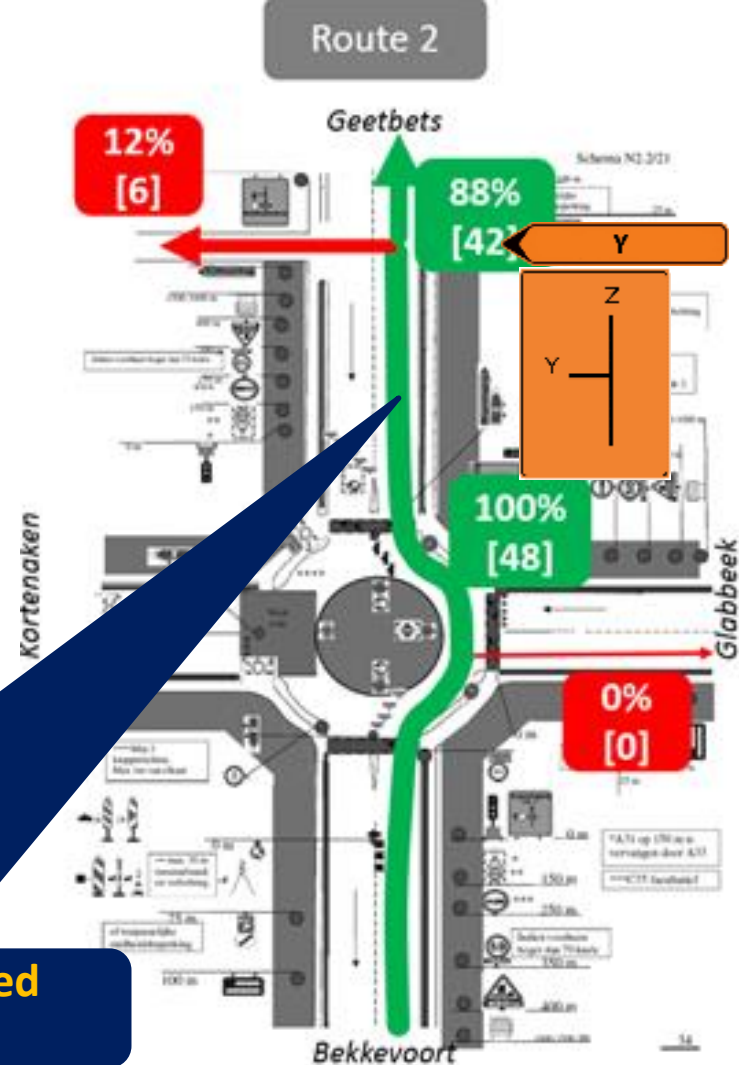
Without roadworks =
with roadworks



Route 2

- **12% incorrect** ($p < .0001$)
 - Leftwards at 3-way
- Recommendation
 - Changing temporary **Wegomlegging** *general* direction sign (diversion) by *specific* direction sign (city name)
 - Extra temporary advance direction sign

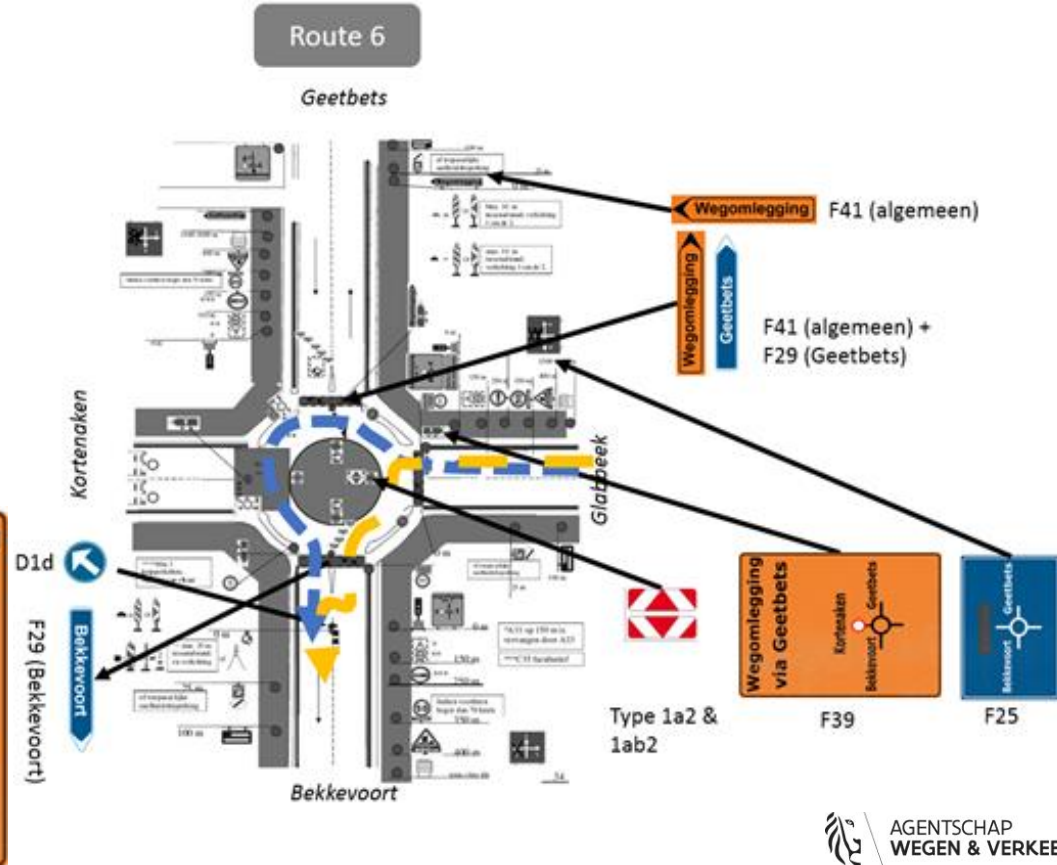
Verbal comment 67% of incorrect (4/6): **followed general diversion sign**



Route 6

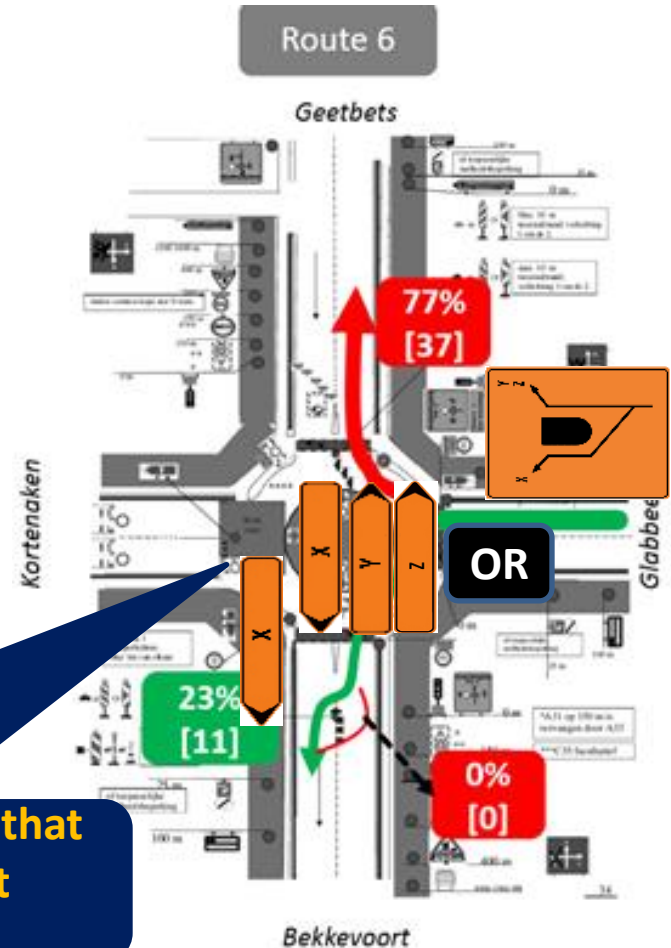
Route 6: From east (Glabbeek) to south (Bekkevoort)

- **Without roadworks:**
normal use of roundabout
= Counterclockwise
- **With roadworks:**
not normal use of roadworks
= Clockwise



Route 6

- **77% incorrect** ($p < .0001$)
 - To the north
- Recommendation
 - Changing specific temporary signalization (clockwise) (2 possibilities)
 - Follow-up study (2017): 0 to 8% wrong



Verbal comment of 68% of incorrect (25/37): **not clear that roundabout is not complete** and **not clear to use it clockwise**

- Validation
 - 1 important adaptation needed
 - 11 smaller recommendations

→ Make detour signs

- (1) as clear as possible
- (2) as specific as possible



Thank you for your attention

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Study conducted by:



Study conducted on behalf of:



References

- [1] European Parliament, "European road safety European Parliament resolution of 27 September 2011 on European road safety 2011-2020 (2010/2235(INI))," European Parliament, 2013/C 56 E/06, Sep. 2011.
- [2] M. G. Lay, "Design of Traffic Signs," in The human factors of transport signs, C. Castro and T. Horberry, Eds. Boca Raton, USA: CRC Press, 2004, pp. 25–48.