

# To change or not to change – that is the question: Detecting lane change signals for anticipatory highly automated driving

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## Motivation

In anticipatory driving, manual drivers are far superior to highly automated vehicles (HAV), e.g. when predicting whether another car is about to start a lane change manoeuvre. Sudden brake manoeuvres of an HAV can be one of the consequences which affect safety and acceptance.

The aim of the study was to investigate which cues experienced drivers use to predict lane change manoeuvres of other cars. This can help to later enable HAVs to better anticipate equivalent situations.

## Summary

A user study ( $N = 17$ ) was conducted using 21 video sequences being paused shortly before a potential lane change of another car. Experienced drivers had to assess the probability of a lane change manoeuvre and name reasons for their decision. The results show that the two most relevant cues for a lane change are indicator usage and a visible reason like an obstacle or slower driver in the neighbouring lane. Other dynamic cues, such as lateral movement and speed differences are also being taken into account by drivers.

## Method

### Participants

- 17 experienced drivers, all male
- Age  $M = 29$  years ( $SD = 5.51$ )
- Distance driven last year  $> 10000$  km

### Material

- 21 video sequences paused shortly before a potential lane change, followed by a blackscreen
- 14 with a lane change, 7 without



Video sequences with lane change (above) and without (below). The blackscreen appeared after the signalling (if present) was visible.

### Assessed variables

- Naming of **all cues** that speak for or against a lane change
  - Estimation of **lane change probability**
- no lane change                      unsure                      lane change
- 
- 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
- Naming of **further cues** that were perceived after the resolution of the situation

## Results

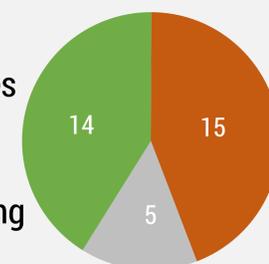
### From quotations to cue categories



### 34 cue categories

#### Pro lane change

- Car accelerates
- Car signals
- Enough space
- Dynamic driving style
- ...



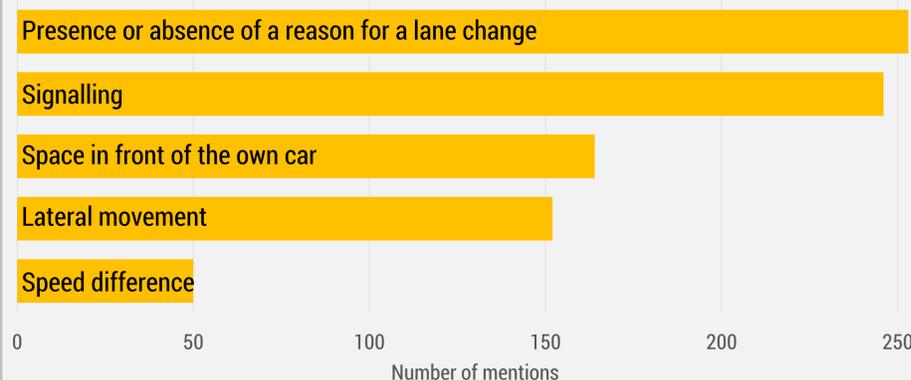
#### Contra lane change

- Car brakes
- No signalling
- No obstacle
- Signalling too long
- ...

#### Neutral

- Traffic jam
- Poor visibility conditions
- ...

### Most frequently mentioned cues



### Significant dependencies of cues and estimated lane change probability

$<20\%$  = no lane change,  $>80\%$  = lane change;  $N \geq 30$

	$N$	$X^2$	$p$ -value
Reason for a lane change (e.g. obstacle)	165	70.73	$<.001$
Car signals	148	52.64	$<.001$
Lateral movement towards the own lane	98	45.72	$<.001$
Enough space in front of the own car	90	23.27	$<.001$
Car does not signal	32	31.27	$<.001$
Own car faster than the other car	31	13.14	$<.001$

