



# Drivers' steering behavior when meeting another car

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## Motivation

Do traffic events, like passing other vehicles, influence the driver's ability to control their heading and lateral position on the road?

Previous research has led to equivocal results. It was suggested:

- that there is a tendency to *steer towards* oncoming vehicles [1],
- that *no such effect* can be observed in real traffic [2],
- or, that drivers seek to *increase the lateral distance* to an approaching vehicle [3, 4], a behavior related to risk avoidance.

Additionally, a number of perceptual factors may account for some systematic behavioral effects when meeting another car. When another car is approaching, (a) the optical flow field is altered, and (b) drivers tend to shift their gaze towards the moving object.

In this experiment we sought to establish a potential influence of an approaching vehicle under highly controlled conditions (in part improving observational conditions, that govern real traffic observation). Among these, we were able to:

- control the speed of the approaching vehicle
- control the preview time
- extend the observation period
- investigate 'being overtaken' and the passing of a 'stationary vehicle'

## Methods

In a driving simulation, nine subjects were instructed to drive in the middle of a single lane at a constant speed of 20 m/s (72 km/h), controlling solely their lateral position. Each subject completed a total of 60 trials, each of which lasted 30 seconds. In each trial, another car could be either **present** or **absent**. If present, it was placed either to the **left** or to the **right** side next to the driver's lane. The other car could be either **stationary in the environment**, moving in the **same direction (overtaking)**, or **opposite direction (approaching)** on a straight path parallel to the lane. Time-of-passage was either 10, 15, or 20 seconds after trial start.



Overtaking situation. Speed of the second car was set to 40 m/s (144 km/h = double speed).

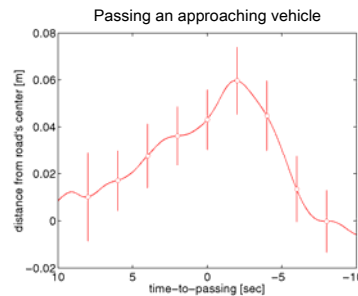


Approaching situation. Path of the second car was parallel to the lane. Speed of both the driver's car and the approaching car was 20 m/s.

## Results

Data analysis was performed on a section of data 10 sec before to 10 sec after the meeting ('meeting': time-to-passage = 0 sec). In the following figures, positive deviation from the center of the road indicate an increased distance to the side of the other vehicle, and vice versa, while error bars represent  $\pm 1$  s.e.m.. Separate analysis of variance was performed for each of the three experimental conditions (approaching / stationary / overtaking). The serial dependence of the time-series was taken into account by applying a Greenhouse-Geisser correction.

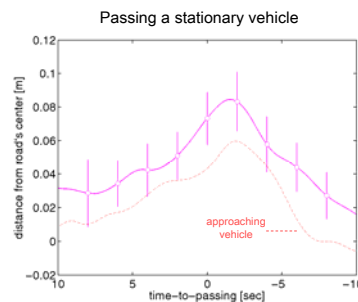
## Results



Significant deviation from the middle of the lane, away from the approaching car ( $F(4.13,665)=4.340$ ;  $p=0.002$ , Greenhouse-Geisser corr.).

Maximum deviation from the center of the lane ca. 2 sec after the meeting.

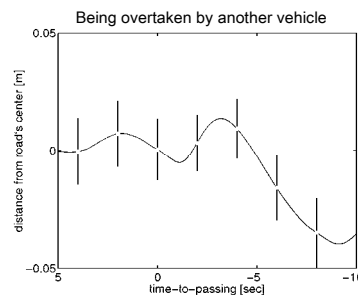
Regaining of the original position occurred ca. 8 sec after the meeting.



When passing a stationary car, the drivers' course also deviated significantly from a straight path ( $F(4.12,663)=3.372$ ;  $p=0.009$ , Greenhouse-Geisser corr.). The resulting motion was away from the stationary vehicle.

Max. deviation ca. 1.5 sec after the meeting.

Comparison with the approaching-vehicle condition revealed a significantly higher deviation when a stationary vehicle is passed ( $F(1,161)=4.605$ ;  $p=0.033$ , no df-correction).



When another vehicle was overtaking, people steered towards the side of the other vehicle ( $F(3.9,634)=2.622$ ;  $p=0.035$ , Greenhouse-Geisser corr.).

Maneuver started ca. 4 seconds after the meeting

Magnitude of the offset is comparable to the two previous conditions.

## Summary & Conclusions

As drivers approached an oncoming or stationary vehicle, they increased the lateral distance towards that car. This results is in accordance with a risk avoidance explanation. However, the maximum deviation occurred not before or close to the meeting point, but approx. 2 sec after the passage. The higher lateral offset found in the condition with a stationary car indicates a prominent role of the object size, not object velocity.

Furthermore, in the absence of any risk potential (overtaking situation), drivers steered to the side of the other vehicle. Since the other vehicle can be regarded as a salient feature in the environment, and therefore frequently fixated, the changed gaze pattern may be intimately linked to the observed steering response. However, this "steering where you look"-hypothesis requires further investigation.

## References

- [1] Helander, M. (1978). Drivers' steering behavior during traffic events: a case of perceptual tropism? *Human Factors*, 20 (6), 681-690.
- [2] Summala, H., Leino, M. & Vierimaa, J. (1981). Drivers' steering behavior when meeting another car: the case of perceptual tropism revisited. *Human Factors*, 23 (6), 683-692.
- [3] Triggs, T. J. (1997). The effect of approaching vehicles on the lateral position of cars traveling on a two-lane rural road. *Australian Psychologist*, 32 (3), 159-163.
- [4] Triggs, T. J. (1980). The influence of oncoming vehicles on automobile lateral position. *Human Factors*, 22 (4), 427-433.