Preprint

This is the submitted version of a paper presented at The Eye, The Brain & The Auto - 8th World Research Congress on Vision and Driving, Detroit, USA, October 7-9, 2018.

Citation for the original published paper:

Hemeren, P. (2018)
Signals for Active Safety Systems to Detect Cyclists and Their Intentions in Traffic
In:

N.B. When citing this work, cite the original published paper.

Permanent link to this version:
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Signals for Active Safety Systems to Detect Cyclists and Their Intentions in Traffic

Objectives: Human cognition is importantly predictive. This predictive ability can also be applied to predict the future actions of cyclists in traffic. Active safety systems in (semi-)autonomous vehicles will likely need to detect and predict human actions occurring in different traffic situations.

Results from two experiments demonstrate the effect of different patterns of human movement on predicting the behavior of the cyclists and the distance it takes drivers to detect the cyclists in a city environment. This research was carried out by observing recorded sequences on a computer but also in a driving simulator in order to include more naturalistic conditions and to achieve a high level of experimental control. As a complement to our previous research (Hemeren et al., 2014), we aimed to determine the distance at which drivers would detect and predict cyclists’ behavior.

Methods: Participants in both experiments (90 participants in experiment 1 and 24 in experiment 2) observed video-recorded cyclists wearing three different patterns of reflective clothing (Fig. 1): biomotion, vest and the legal minimum requirement (legal), in which no reflector material was worn by the cyclists. In experiment 1, participants were instructed to predict if an approaching cyclist would make a left-turn or continue straight on when approaching a crossing. This task was also performed during daylight, dusk and at night. In the second experiment, participants in a driving simulator indicated (as a secondary task) when they saw a cyclist riding along the side of the road.

Results: The biomotion reflective clothing led to a prediction accuracy of 88% for cyclists’ intentions at 9 meters before a crossing for the nighttime condition. For the legal minimum, the result was 59% and for the vest 67%.

Detection distance (Fig. 2) in the driving simulator was also significantly greater for the biomotion condition compared to the legal and vest conditions. Visual detection is almost twice the distance for biomotion compared to the other two reflective clothing conditions.

Conclusions: The results point to the critical role that biological motion can play on predicting the intention and detection of cyclists in traffic. This information can be used to inform (semi-)autonomous systems of human intentions in traffic.
Figure 2: Mean detection distance (meters) as function of reflector condition in Exp. 2.