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MeBeSafe: Developing and testing infrastructure & car based nudges to improve cyclist safety

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1 INTRODUCTION

MeBeSafe (Measures for Behaving Safely in Traffic) is a 3.5 year project funded by the European Commission that started 1 May 2017. The project objectives are to develop novel measures, using sensor-based feedback, to 'nudge and to coach' CYCLISTS AND DRIVERS towards a safer traffic behaviour, to apply these measures in field settings and to evaluate their effects. 'Nudging' measures will be used to subconsciously pushing road users to make a desired choice, without being prohibitive against other choices of action. Such measures are less invasive, give road users choices, and can be provided earlier in a chain of events that might be leading to a critical situation.

The project aims to develop two measures to improve cyclist safety: an infrastructure-based 'nudge' measure to stimulate a safe riding speed when approaching and negotiating intersections, and a car-based measure to predict cyclist intent. The latter will contribute to the development towards autonomous cars that interact adequately with cyclists.

2 BACKGROUND

The popularity of cycling is booming worldwide, due to its many positive impacts on health, environment and accessibility (Gerike and Parkin, 2015). Unfortunately, in most traffic systems, cyclists are highly exposed to road risks (OECD/ International Transport Forum, 2013). In 2014, more than 2,000 cyclist deaths were recorded in the EU alone. Many more were seriously injured, but actual numbers or reliable estimates are not available (ETSC, 2016). Today, even in a cycling friendly country like the Netherlands – frequently serving as a model to promote cycling elsewhere – cyclists stand for about a third of all road fatalities and more than half of all serious road injuries (Schepers et al., 2015). Whereas in the last decades huge safety gains have been achieved for car occupants, the protection of cyclists has been far less successful. Yet, policies to protect cyclists are scarce (ETSC, 2016). Fundamental research for the development of such policies is still in its infancy and is hampered by many limitations, such as incomplete data on bicycle crashes, lack of funding and focus, as well as shortcomings in methods suitable for research on bicycle safety. In 30.302 papers on traffic safety indexed in Science Direct for the years 2012 to 2016, only 7.8 per cent dealt with the safety of cycling (Twisk et al., 2017).

Road accidents clearly show a number of high-level causation factors: failure to look properly (lack of attention) and excessive speed for the circumstances (leading to loss of control and failure to timely spot hazards). These

types of causation factors will be addressed in the MeBeSafe project, and nudging measures will be developed for car drivers interacting with cyclists, and for cyclists approaching risky intersections. For cyclists, the objective is to get 20 per cent of the cyclists to reduce their speed below a speed threshold when approaching urban intersections.

3 NUDGING AND COACHING APPROACH TO SAFER ROAD BEHAVIOUR

The central concept of the MeBeSafe project is to use 'nudging and coaching measures' to change habitual traffic behaviour and motivate cyclists and drivers to preserve adequate traffic safety margins.

For most of us, navigating traffic is a very common activity and habitual. Our behaviour neither requires a lot of elaborate conscious decision-making, nor is it purely automatic or reflexive. Most current measures intended to get road users to behave safely appeal to our deliberate self, act autonomously on our behalf (autonomous braking, traffic lights), or seek to assist us by presenting feedback/information (e.g. Forward Collision Warning, roadside speed displays). However, the latter category of measures is often not effective as users either switch them off or do not act upon the information provided.

The nudging concept, adapted from behavioural science, relates to subconsciously pushing us to make a desired choice, without forcing us if we want to go a different way (Thaler and Sunstein, 2009). By preserving our freedom of action and giving us choice, nudging measures are less intrusive and can be provided earlier in a chain of events that might lead to a critical situation. The approach is based on fundamental research on cognitive biases and automatic responses to our environment (Kahneman, 2003).

This project seeks to change the user's habits over the longer term. For cycling safety, 'nudging' is a promising and fairly new approach. Nudging measures will be designed directed towards cyclists by exploiting sensor information for tailored feedback.

4 IN-VEHICLE AND INFRASTRUCTURE BASED NUDGES FOR CYCLIST SAFETY

Cyclist behaviour is not primarily governed by rules (e.g. there are no speed limits for cyclists in most countries) but by convenience and self-preservation. The growing number of e-bikes entails that higher speeds will be achievable for a greater number of cyclists. Cyclists are often reluctant to brake to slow down, as they will have to put in additional energy to get back up to speed after braking. They become less predictable and are in danger of being disregarded by human drivers and automated safety systems alike. Predictable speeds are therefore of utmost importance when approaching risky intersections, as well as automated systems to be able to predict target intent. (See also the EU project PROSPECT).

4.1 In-vehicle measures – nudging car drivers to timely anticipate cyclist behaviours

The objective for car drivers in the MeBeSafe project is to provide drivers with feedback to assist them in detecting cyclists on a collision course, and to affect their appraisal of risk. This is expected to help road users to increase their chosen safety margins, and will make them aware of hazards, without getting them into crashes. Although some progressions have been made for the prediction of pedestrian intent, predicting target intent for cyclists, crossing the path of a car, continues to be a challenge. PROSPECT made a first start in cyclist trajectory prediction, using infrastructure or bicycle based sensors.
Within the MeBeSafe project, risk forecasting algorithms will be developed to detect these bicycle related hazards and to direct driver attention to the potential hazards. For the development of such algorithms, 'deep learning' will be used, which will be trained on and derived from historic traffic data (video images).

4.2 Infrastructure measures – nudging cyclists to reduce their speed

A large number of safety measures have been proposed or enacted that are intended to reduce the number and the severity of cyclist accidents. Measures that have been shown to have a positive effect include the use of cycling helmets, rural street lighting, and the separation of cycles and motorised vehicles through the installation of bike lanes and cycle paths. There are also a number of measures of which a positive effect has not yet been conclusively demonstrated, including priority traffic signals, advanced stop lines and bike boxes, spaces at signalized intersections reserved for cyclists, placing them in front of motorised traffic. None of these measures tackle risky behaviour by the cyclists themselves. It has been shown that excessive speed (and speed difference) is a major contributing factor to the occurrence and severity of bicycle accidents. Some (very unpopular) measures that have been tried, is to put bollards or other obstacles in the cyclist's path, but these are often avoided by riding on the roadway. With the increasing popularity of e-bikes capable of sustaining a higher speed with reduced cyclist effort, the cyclist speeding problem will only get worse. In some cities, speed-reducing measures used for motor vehicles have been adapted for use with bicycles. In Los Angeles, the LADOT bike program introduced dedicated rumble strips for cyclists – no results have been published. In Stockholm, rumble areas have been used, but again no data is available on their effect. The problem is not the lack of ideas of cyclist-specific speed reducing measures, but the lack of data on their effectiveness which severely limits their adoption.

5 WORK PLAN

For the cyclist-speed-nudge, the project is looking to implement two speed reducing measures for cyclists approaching intersections – one using some form of rumble strip and one using interactive visual warning information. Field tests with these measures will mainly be conducted in two countries with a high number of cyclists (Sweden and the Netherlands) to generate authoritative evidence in order to inform policy choices, leading to wider adoption of the measures. This task includes the detailed designing and test track testing of measures to make a pre-selection of the most effective nudging designs (one haptic and one visual) to be implemented for real life testing.

For the in-vehicle nudging solutions for directing driver attention towards cyclists, an intelligent sensing system, and an HMI necessary for nudging users into safer behaviour at intersections will be developed. Part of the intelligence will be the 'prediction of cyclist intent'. The implementation involves a newly developed world model with traffic rules and details on the infrastructure layout that determine where possible hazardous situations might occur. Driver simulations will be used to select different test situations.

To provide the appropriate nudging information towards the driver in an earlier stage than when a critical situation is imminent, information on the intent of cyclists that might interfere with the path of the host vehicle needs to be available some seconds before the critical situation occurs. This information comes available from the interpretation of the vehicle's sensor system. Based on the bicycle's trajectory over the last few seconds, a prediction is made over the intended trajectory for the coming seconds. The prediction will come with an estimated probability of the cyclist's manoeuvres.

6 PARTNERS IN THESE TASKS

The task on "Sensing and predicting cyclist intent' is led by Cygnify BV (www.cygnify-solutions.com) and will be carried out in cooperation with TNO, Dutch Organization for Applied Scientific Research (www.tno.nl), SWOV, Institute for Road Safety Research (www.swov.nl), SAFER Vehicle and Traffic Safety Centre at Chalmers (www.chalmers.se/safer), and OFFIS, the Institute for Information Technology (www.offis.de).

The task on 'Cyclist nudge by infrastructure design' is led by SAFER and is carried out in cooperation with TNO and SWOV.

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