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<b>Title of presentation</b>  Is a train coming? - Effects of two low-cost safety measures on road user behavior at a passive level crossing	<b>Institution</b>  DLR Institute of Transportation Systems
<b>Please highlight workshop topic(s) your paper is relevant for</b>  <input type="checkbox"/> <b>Ergonomics and Usability of advisory and assistance systems</b> <input type="checkbox"/> <b>Risk, Human error and Human reliability</b> <input type="checkbox"/> <b>Situation awareness</b> <input type="checkbox"/> <b>others</b>	
<b>Abstract</b> <p>Level crossings (LC) are a hotspot of accidents in rail transport, and a dangerous accident site to road users. Beside the severe damages to life and health that often occur on the road side, LC accidents entail substantial costs due to disruptions in railway operations as well as material and environmental damage. Most LC accidents are caused by problematic road user behavior. At passive LC (LC without technical safety infrastructure), this mainly involves deficient visual scanning for trains before crossing the tracks.</p> <p>The EU project SAFER-LC focused on the development and evaluation of affordable safety measures to facilitate safe road user behavior at LC. Within this scope, the current study examined measures for passive LC and vulnerable road users (VRU). Two low-cost LC safety measures were piloted in a real traffic environment: (1) a road marking “← Is a train coming? →” on LC approach, and (2) a blinking amber light with a train symbol positioned at the road side ahead of the tracks. Both measures aim at increasing the probability for road users to scan the tracks to the left and right before crossing. The measures were implemented for two weeks each at a passive LC mainly frequented by bicyclists and pedestrians in Braunschweig (Germany) in addition to the existing passive safety infrastructure. Behavioral changes were assessed based on data from a mobile traffic data acquisition system including low-resolution video recordings. Data were gathered during the two test phases and a baseline assessment phase. Characteristics of behavior on LC approach were determined for a sample of 240 VRU by video annotation, with primary interest on head movements to the left and right as an indicator of visual scanning behavior.</p> <p>In the baseline condition with standard passive safety infrastructure, a little more than one third of VRUs were found to scan the tracks to both sides on LC approach, while around 40% showed no signs at all of visual scanning. The proportion of VRU looking to both sides increased to around one half in the condition with the road marking, and to around three quarters when the blinking amber light was applied. The proportion of VRU showing no visual scanning at all decreased in both test conditions. No differences were observed in the behavioral responses of bicyclists as compared to pedestrians. Neither was the observed visual scanning behavior found to be associated with the time of measurement (beginning vs. end of the implementation period) or VRU gender.</p> <p>We conclude that VRU behavior at passive level crossings can be positively influenced by low-cost safety measures applied complementarily to the existing safety infrastructure. As the observation period was rather short, however, the longevity of effects remains to be studied in further research. Another aim for future research could be to test the measures' effectiveness for motorized road users, too. In general, the application of complementary human-centered measures to guide road user behavior at level crossings appears as a practicable way of increasing safety in both rail and road transport.</p>	